



# RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

EDITOR

Howard P. Doub, M.D.  
Detroit, Michigan



Volume 47

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Illustrations and tables should be kept within reasonable bounds, as the number which can be published without cost to the author is strictly limited. For excess figures and for illustrations in color, estimates will be furnished by the Editor. Photographic prints should be clear and distinct and on glossy paper. Drawings and charts should be in India ink on white or on blue-lined coordinate paper. Blueprints will not reproduce satisfactorily. All photographs and drawings should be numbered; the top should be indicated, and each should be accompanied by a legend with a corresponding number. Authors are requested to indicate on prints made from photomicrographs the different types of cells to which attention is directed, by drawing lines in India ink and writing in the margin. The lines will be reproduced, and the words will be set in type. Attention should be called to points which should be brought out in completed illustrations, by tracings and suitable texts. These instructions should be concise and clear.

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# RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol 47

DECEMBER 1946

No 6

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# RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCE

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

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Vol 47

JULY 1946

No 1

## The Early Pneumoencephalographic Findings Following Penetrating Wounds of the Brain<sup>1</sup>

LT COL J E LOFSTROM,<sup>2</sup> M C, A U S, LT COL J E WEBSTER,<sup>2</sup> M C, A U S,  
and CAPT R C SCHNEIDER,<sup>2</sup> M C, A U S

NEUROLOGICAL sequelae which are the result of penetrating wounds of the brain may call for pneumoencephalography at various periods after the initial injury. This report is based upon studies made upon patients during postoperative care while in the theater of operations. Roentgen examination was done, as a rule, in an attempt to assist in the diagnosis or localization of subdural hematoma or complicating brain abscesses when clinical studies alone were inconclusive. The purpose of this presentation is to record the degree and rapidity with which hydrodynamic effects are manifested in the ventricular system. Such observations may aid in the evaluation of the roentgen findings in later periods of convalescence, or in the explanation of late neurologic sequelae.

### MATERIAL

The 23 pneumoencephalographic studies reported were made during the care of 256 patients with penetrating cranial wounds at the 36th General Hospital, in the European theater. Dural penetrations occurred in 206 of this group. The majority of the patients underwent primary operation in an American evacuation hospital.

The 256 patients are divided into two groups: (1) 146 with penetrating cranial wounds, of whom 119 showed dural penetration, observed during one phase of operation in the European theater, (2) 110 with cranial wounds, with 87 cases of dural penetration, who were studied during a second phase.

In the first group, routine roentgen studies revealed the presence of retained bone fragments within the brain after primary débridement in 11 per cent, of retained metallic fragments in 27 per cent. A survey showed that brain abscess was a complication in 33 or 16 per cent of the 206 patients with dural penetration.

The time at which the pneumoencephalograms were made varied from fourteen to ninety days after the original injury, which corresponds essentially with the date of primary débridement. Several patients had studies made after secondary surgery. Two had evacuations of brain abscesses prior to encephalography. The lesions in the patients upon whom the studies were carried out represented a fairly good cross section of the general type and severity of injuries, as well as complications, encountered in the whole group of 256 patients.

<sup>1</sup> From the Departments of Radiology and Neurosurgery, 36th General Hospital (affiliated with Wayne University College of Medicine, Detroit, Mich.), Army of the United States. Accepted for publication in July 1945.

<sup>2</sup> Released from service. Now at Wayne University College of Medicine and St. Mary's Hospital, Detroit, Mich.

<sup>3</sup> Released from service. Now at University of Michigan Medical School, Ann Arbor, Mich.

TABLE I

Case Number	Date of Primary Débridement	Tissue Loss	Bone Defect		Bone Fragments	Metallic F B Size in mm	Interval (days)	Pressure Defect	Dilatation of Ventricles				Displacement	Sub-arachnoid Air Pattern		Remarks
			Size in cm	Location					Right	Left	3d	4th		Right	Left	
1	1/30/44	++	7 × 7	Left parietal	3	0	37	↑	N	+	N	N	↑	N	0	3 cm abscess, left (Fig 1, A) Abscess debrided (Fig 1, B)
1		++					79	0	+	+	+	+	↑	0	0	
2	2/5/44	++	5 × 5	Left parietal	0	0	30	↑	+	N	N	N	↑	0	0	Left temporal abscess
3	9/23/44	0	5 × 3 5	Right fronto parietal	0	0	43	0	+	+	N	N	↑	0	+	Hygroma, right intact (Fig 2) See Fig 3
4	2/1/44	++	13 × 0	Right fronto parietal	1	0	77	0	+	+	N	N	↑	0	+	
5	2/13/44	++	3 5 × 3 5	Left parietal	0	0	95	0	+	+	+	+	↑	0	0	Previous abscess (Fig 4) Bursting fracture (Fig 5)
6	2/13/44	?	3 × 0	Frontal	0	7	21	0	+	+	+	+	↑	0	N	
7	2/11/44	?	3 × 3	Left	0	0	61	0	+	+	N	N	↑	0	0	Bursting fracture (Fig 6)
8	10/24/44	++	10 × 4	Right parietal	++	2 × 8	11	0	+	N	N	N	0	0	-	Early change (Fig 7, A) Progressive dilatation (Fig 7, B)
8							71	0	+	N	N	N	0	0	0	Suboccipital decompression (Fig 8) Subdural hematoma (Fig 9)
9	11/15/44	++	Large	Occipital	0	10 × 14	66	0	+	N	+	+	0	post	0	Previous left parietal abscess (Fig 10)
10	2/11/44	0	4 × 10	Left fronto parietal	0	0	28	0	N	N	N	N	↑	N	0	Dura intact Sterile bone fragments
11	2/7/44	++	4 × 4	Left parietal	0	0	63	0	N	N	N	N	0	+	local	
12	1/29/44	++	7 5 × 7 5	Left parietal	2	0	64	0	+	+	N	N	↑	+	+	
13	11/9/44	0	4 × 2 5	Left parietal	1	0	43	0	N	+	N	N	0	N	+	
14	2/6/44	?	5 × 5	Right frontal	2	10	43	0	+	+	N	N	0	+	+	
15	1/18/44	+	5 × 4	Right temporal	0	0	80	0	N	+	N	N	0	+	+	
16	2/17/44	++	3 × 2	Left parietal	0	0	46	0	N	+	N	N	0	+	+	
17	2/12/44	++	6 × 9	Left parietal	3	0	55	0	N	+	N	N	0	+	+	
18	9/25/44				0	0	30	0	N	+	N	N	0	+	+	
19	11/17/44	++	6 × 6	Right parietal	0	0	21	0	N	+	N	N	0	+	+	
20	12/3/44	++	3 × 3	Left frontal	1	0	25	0	N	+	N	N	0	+	+	
21	12/4/44	++	3 × 0	Right fronto-parietal	3	4 × 10 6 × 11	26	0	N	+	N	N	0	+	+	

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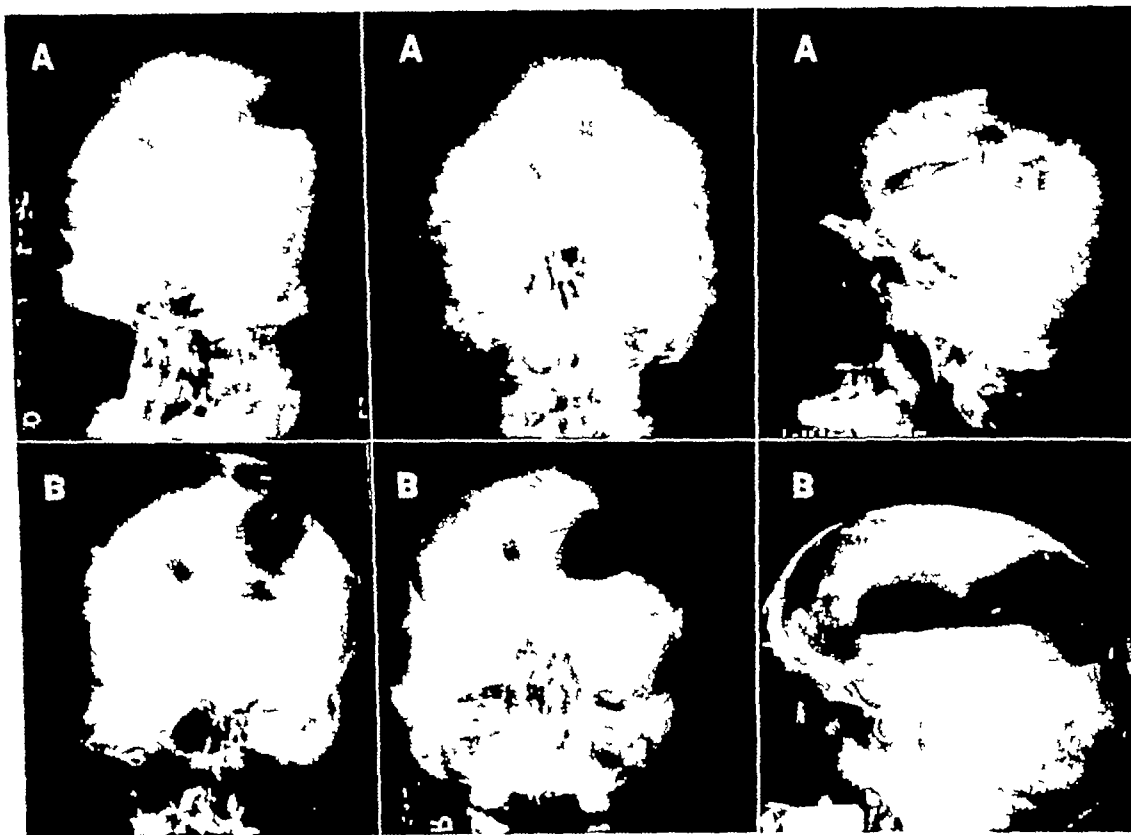


Fig 1 Case 1 37 and 79 days postoperative

**A** Thirty seven days postoperative Severe loss of cerebral tissue left side, bone defect 7 cm in diameter, intracerebral bone fragment medial and superior to abscess cavity outlined by air, posterior horn of left lateral ventricle displaced superiorly and medially, loss of subarachnoid air shadow on left, subdural collection on right

**Diagnosis** Brain abscess with slight dilatation of left lateral ventricle Arachnoiditis left

**B** Seventy-nine days postoperative (the brain abscess shown in A had been débrided) Marked increase in the size of the left lateral ventricle with elevation posteriorly, slight ipsilateral shift of the entire system on a compensatory basis Slight enlargement of the right lateral, third, and fourth ventricles was also noted

**Diagnosis** Postoperative hydrodynamic compensation with ventricular dilatation, severe, and shift Arachnoiditis generalized

## RESULTS

Table I is a summary of the pertinent data relative to the wounds and general surgical procedures, as well as the pneumoencephalographic findings. An attempt has been made to estimate the degree of loss of brain substance sustained at the primary débridements prior to encephalography. In some instances this was impossible due to lack of clarity in previous records. The size of the bone defect is noted, and the interval between injury and the pneumoencephalogram is recorded. The subarachnoid distribution of air is also indicated in the table.

Two cases of brain abscess were demonstrated. In one the abscess cavity itself

was outlined by the injected air (Case 1, Fig 1). The second showed evidence of a mass lesion with local pressure defects. Two other instances of subdural collections were detected in the 23 examinations. In one of the two (Case 3, Fig 2), trephination revealed a hygroma as localized.

Of the entire group, only 3 showed a normal subarachnoid air pattern. The remainder manifested either localized or generalized obliteration of air shadows.

In Cases 4 and 5 the roentgen studies were made after evacuation of an abscess, thus representing considerable brain tissue loss due to the two operative procedures, the primary débridement and the débridement of the abscess. Figures 3 and 4 present the ventricular patterns at postopera-



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1		++					79	↑	+	++	+	+	↑	0	0	Abscess debrided (Fig 1, B)
2	2/5/44	++	5 × 5	Left parietal	0	0	30	↑	+	N	/	/	↑	0	0	Left temporal abscess
3	9/23/44	0	5 × 3 5	Right fronto-parietal	0	0	43	0	++	++	/	/	↑	0	+	Hygroma, right Dura intact (Fig 2)
4	2/1/44	++	13 × 6	Right fronto-parietal	1	0	77	0	++	+	/	/	↑	0	+	Sec 1 Fig 3
5	2/13/44	++	3 5 × 3 5	Left parietal	0	0	95	0	++	++	+	+	↑	0	0	Previous abscess (Fig 4)
6	2/13/44	?	3 × 6	Frontal	0	7	21	0	++	++	+	+	0	0	N	Bursting fracture (Fig 5)
7	2/11/44	?	3 × 3	Left	0	0	61	0	+	++	/	/	↑	0	0	Bursting fracture (Fig 6)
8	10/24/44	++	10 × 4	Right parietal	++	2 × 9	11	0	++	N	/	/	0	0	-	Early change (Fig 7, A)
8							71	0	++	N	/	/	0	0	0	Progressive dilatation (Fig 7, B)
9	11/15/44	++	Large	Occipital	0	10 × 14	60	0	++	/	+	+	0	0	0	Suboccipital decompression (Fig 8)
10	2/11/44	0	4 × 10	Left fronto-parietal	0	0	28	0	N	N	N	N	↑	post	0	Subdural hematoma (Fig 9)
11	2/7/44	++	4 × 4	Left parietal	0	0	63	0	N	N	N	N	0	+	0	Previous left parietal abscess (Fig 10)
12	1/29/44	++	7 5 × 7 5	Left parietal	2	0	64	0	/	++	N	N	0	+	local	Dura intact
13	11/9/44	0	4 × 2 5	Left parietal	1	0	33	0	/	++	N	N	0	+	+	Sterile bone fragments
14	2/6/44	?	5 5 × 5	Right frontal	2	10	43	0	++	N	N	N	0	+	+	
15	1/18/44	+	3 × 2	Right temporal	0	0	90	0	N	+	N	N	0	+	+	
16	2/17/44	++	9 × 6	Left parietal	0	0	16	0	N	++	N	N	0	+	+	
17	2/12/44	++	6 × 9	Left parietal	3	0	55	0	N	++	N	N	0	+	+	
18	9/25/44	+			0	0	30	0	N	+	N	N	0	+	+	
19	11/17/44	++	6 × 6	Right parietal	0	0	21	0	N	++	N	N	0	+	+	
20	12/3/44	++	3 × 3	Left frontal	1	0	25	0	N	++	N	N	0	+	+	
21	12/4/44	+	3 × 6	Right fronto-parietal	3	4 × 10 6 × 11	26	0	N	++	N	N	0	+	+	

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 ++ moderate  
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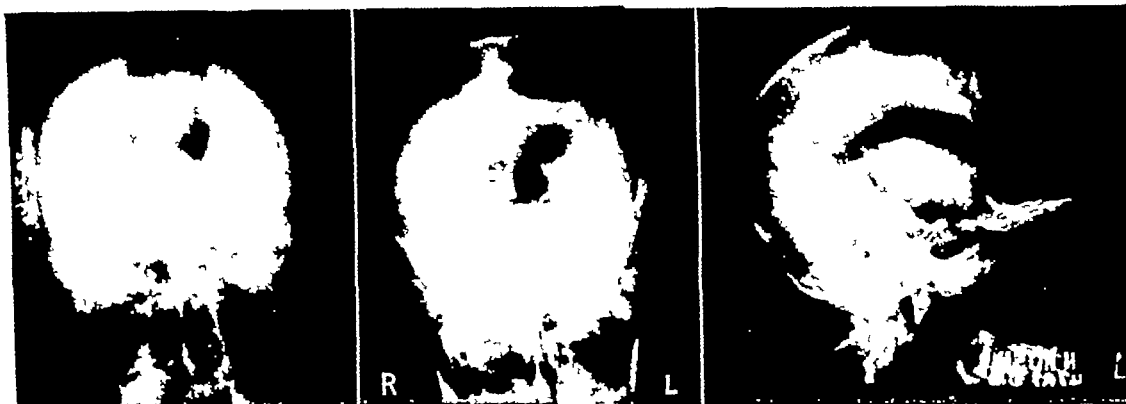


Fig 4 Case 5 95 days postoperative This patient had had both primary wound débridement and secondary débridement of brain abscess, representing severe loss of cerebral tissue Bone defect 3.5 cm diameter, left parietal Marked dilatation of left lateral ventricle with slight dilatation of right is noted There is a slight ipsilateral shift of the entire system No subarachnoid air pattern is evident on either side

*Diagnosis* Postoperative hydrodynamic compensation with ventricular enlargement and shift Adhesive arachnoiditis, generalized

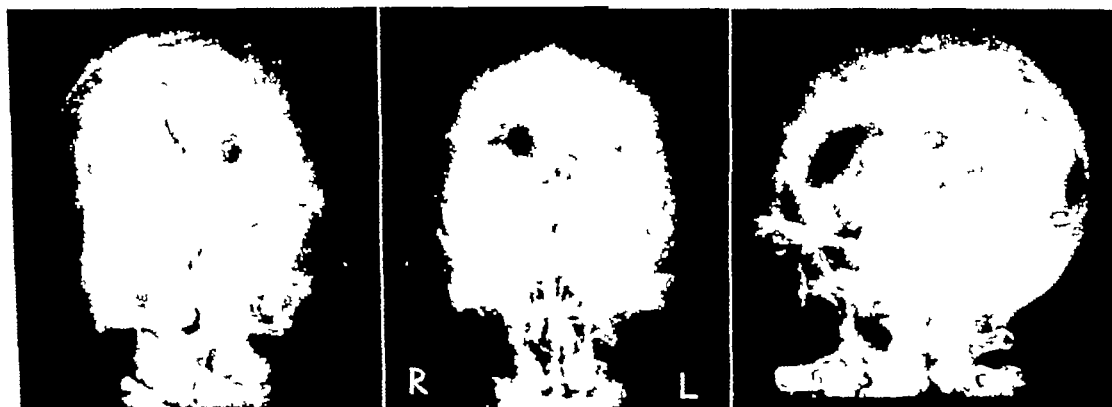


Fig 5 Case 6 21 days postoperative Mid-frontal defect 3 × 6 cm Shell fragment 7 mm in diameter is seen in posterior fossa, having traversed the right hemisphere Degree of loss of cerebral tissue not clearly defined in previous records

Moderate dilatation of the right lateral ventricle and slight enlargement of left lateral and third ventricles No significant shift is demonstrated No subarachnoid air pattern is present on the right

*Diagnosis* Postoperative hydrodynamic compensation with ventricular enlargement Adhesive arachnoiditis, right

of the right lateral ventricle and moderate enlargement of the third ventricle Absence of the subarachnoid air pattern over the posterior area was striking

In Case 10 there was no brain tissue loss at the time of primary operation, and the ventricular pattern was normal except for a slight contralateral shift and an absence of subarachnoid air on the left, associated with a subdural hematoma (Fig 9)

The only instance of a normal pneumoencephalogram associated with a considerable destruction of cerebral tissue is shown in Figure 10 (Case 11)

## DISCUSSION

From the observations made upon this small group of cases, it appeared that ipsilateral ventricular enlargement usually followed the débridement of a brain wound As the degree of brain loss increased, the ventricular enlargement became more diffuse, the enlargement reaching fully 200 per cent of normal, as in Case 1 In one instance, however (Case 11), the ventricular system was normal in spite of a significant loss of tissue Usually, a severe loss of cerebral substance resulted in dilatation of the contralateral ventricle as

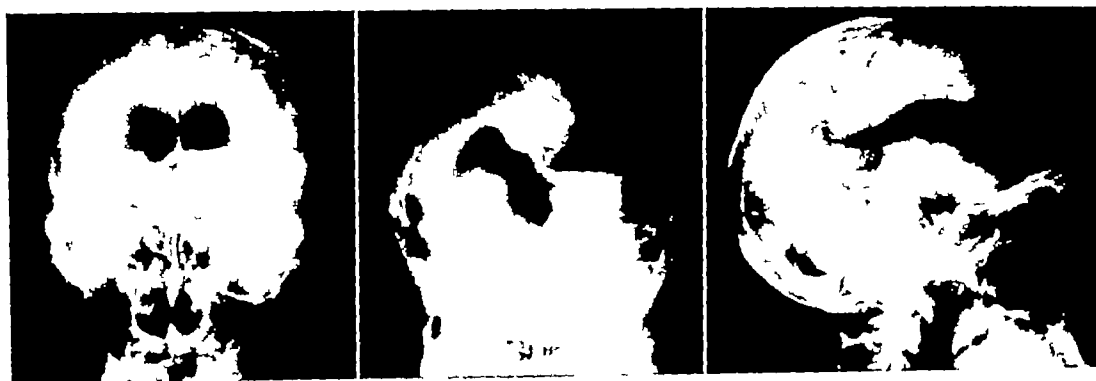


Fig 2 Case 3 43 days postoperative Right frontoparietal defect  $5.0 \times 3.5$  cm, dura intact and no cerebral tissue loss, generalized, symmetrical dilatation of ventricles of moderate degree, slight shift of the system to the left, with obliteration of subarachnoid pathways on right

*Diagnosis* Post-traumatic ventricular dilatation Mass lesion right Operative findings of hygroma over right hemisphere

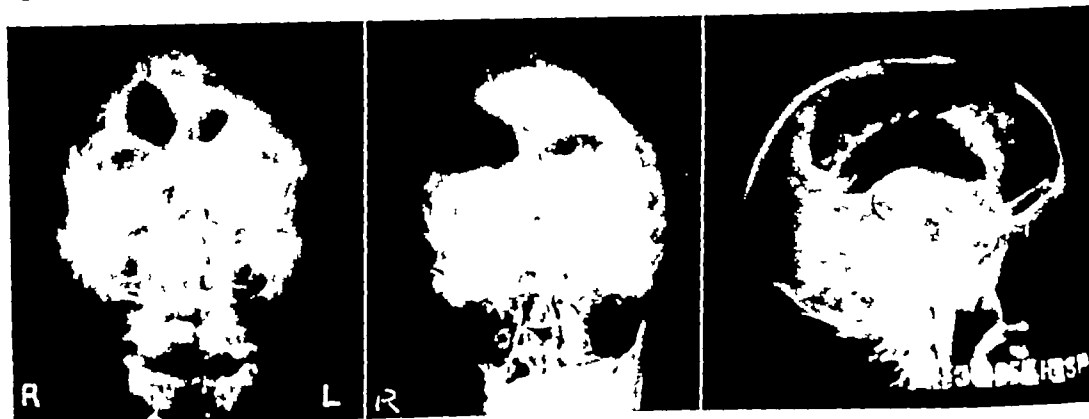


Fig 3 Case 4 77 days postoperative Largest bone defect in this group of cases— $13 \times 6$  cm, right frontoparietal This patient had had primary débridement and later a débridement of a complicating abscess, representing severe loss of cerebral tissue

Marked dilatation of the right lateral ventricle is noted, with slight ipsilateral shift of the entire system Slight enlargement of the left lateral is also present There is a decreased subarachnoid air shadow on the right, accentuated on the unaffected side

*Diagnosis* Postoperative hydrodynamic compensation with ventricular enlargement and shift Adhesive arachnoiditis, right

tive periods of seventy-seven and ninety-five days, respectively Case 4 presented the largest bone defect of the group,  $13 \times 6$  cm

Roentgenograms were made twenty-one days following the primary operation in Case 6, and the increase in the size of the ventricle at this period is shown in Figure 5 The effect of a perforating wound through the hemisphere associated with a bursting type of fracture (Case 7) is shown in Figure 6

In Case 8 (Fig 7) the first pneumoencephalogram was done at fourteen days, the earliest of any of the series This

patient had a large bone defect and had sustained severe tissue loss Early but definite enlargement of the ipsilateral ventricle was demonstrated A subsequent examination done at seventy-one days revealed progression of the dilatation with associated shifting of the ventricles to the affected side

Marked enlargement of the fourth ventricle following occipital and suboccipital decompression with primary débridement and later removal of a shell fragment from the vermis of the cerebellum was found in Case 9 (Fig 8) There was considerable associated dilatation of the posterior horn



Fig 8 Case 9 66 days postoperative Moderate loss of cerebral tissue, large occipital and suboccipital defect Foreign bodies were removed from area adjacent to the fourth ventricle at secondary surgery

There is considerable dilatation of the posterior body and horn of the right lateral ventricle, with moderate enlargement of the third and marked enlargement of the fourth ventricle There is no significant shift of the system Subarachnoid pathways are obliterated in the cerebellar area and over the posterior cerebrum The cisternae are slightly dilated

*Diagnosis* Postoperative hydrodynamic compensation with ventricular dilatation posteriorly Adhesive arachnoiditis, posterior

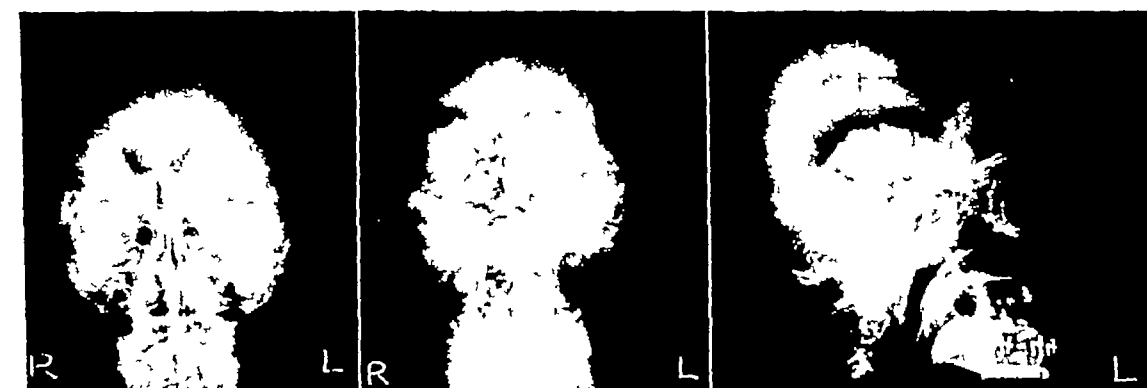


Fig 9 Case 10 28 days postoperative No cerebral tissue loss, 4 × 10-cm left frontoparietal bone defect, no ventricular dilatation, minimal shift of ventricles contralaterally Subarachnoid pathways on the left are obliterated

*Diagnosis* Mass lesion left Subdural hematoma Arachnoiditis left

tomy Closure of the dura at the time of operation did not appear to be an important factor It is of note that marked ventricular distortions occurred with small bone defects and in the presence of a tightly closed dura or dural graft

Inasmuch as all of these patients had sustained definite brain injury, mainly severe, and were from a previously healthy group of young males, it would seem reasonable to exclude unrelated pathologic conditions in an appraisal of the pneumoencephalographic findings Osmond (1) has reviewed the literature and presented the theories and evidence of Winkelman and Fay, Osnato and Gliberti, Penfield,

Grant, Dyke, and others, to explain the pneumoencephalographic findings in post-traumatic conditions of the brain The presence of dilatation of the ventricular system following "closed" cranial injury has been repeatedly demonstrated The mechanism remains controversial The pronounced degree of dilatation in several of this group soon after débridement of brain tissue leaves little doubt that it was on the basis of hydrodynamic compensation A definite volume of brain tissue had been removed and the space was filled first by fluid or swollen brain substance and later by the ventricles dilated as a result of the positive pressure of the cerebrospinal

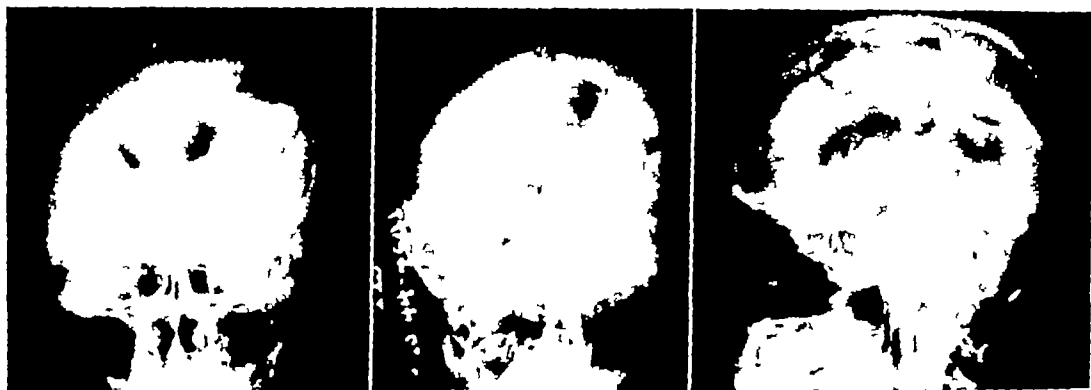


Fig 6 Case 7 61 days postoperative Penetrating wound with bursting type of fracture Degree of cerebral tissue loss at debridement was not clearly defined in early records Bone defect  $3 \times 3$  cm in addition to defects produced by separation of bone fragments of fractures involving right frontal, parietal, and occipital areas

Moderate dilatation of right lateral ventricle is noted, with slight enlargement of left lateral and third ventricles No shift is present Subarachnoid pathways are obliterated on the right Cisternae slightly dilated

*Diagnosis* Postoperative hydrodynamic compensation with ventricular enlargement Adhesive arachnoiditis, right

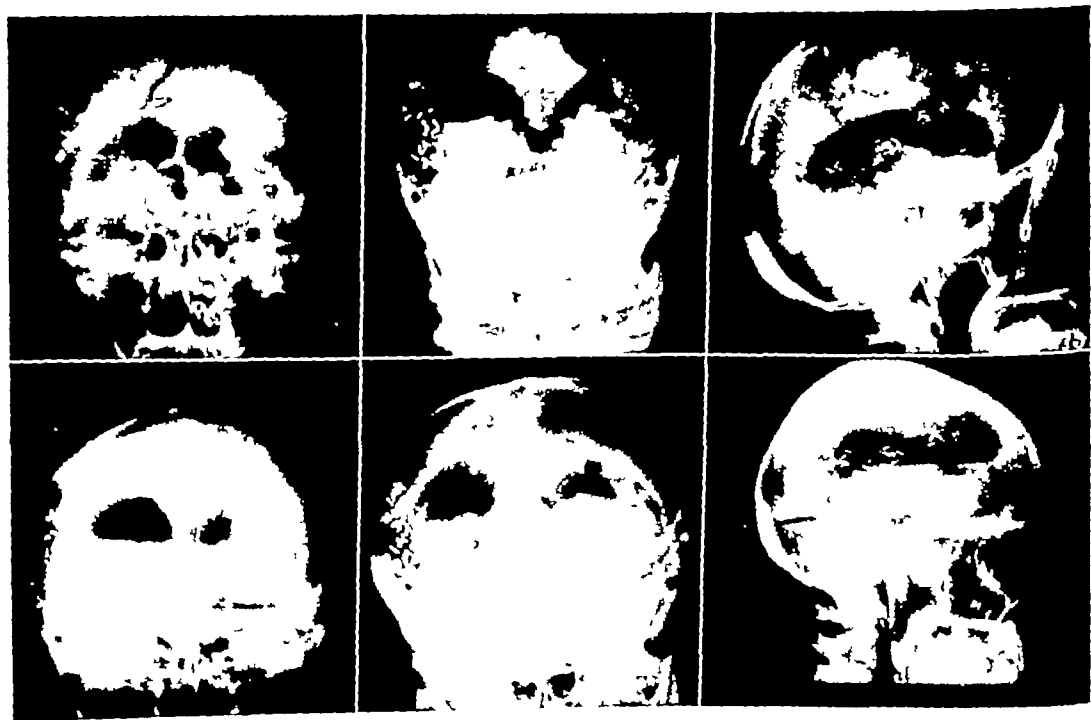


Fig 7 Case 8 14 and 71 days postoperative

The three upper views, made 14 days postoperative, show severe cerebral tissue loss bone defect  $10.5 \times 3.5$  cm, right parietal Moderate dilatation of right lateral ventricle is present No significant shift is present Subarachnoid space obliterated over right side and decreased on left

The three lower views were made 71 days postoperative The progression in the enlargement of the right lateral ventricle is illustrated, with generalized ipsilateral shift Subarachnoid space not visualized

*Diagnosis* Postoperative hydrodynamic compensation with marked ventricular enlargement and slight shift Adhesive arachnoiditis

well as the ipsilateral one, and in a shifting of the entire system to the affected side At this early period, the ventricular dis-

tortions appeared to be related to the loss of brain tissue rather than to the size of the bony defect produced by craniectomy.



Fig 8 Case 9 66 days postoperative. Moderate loss of cerebral tissue, large occipital and suboccipital defects. Foreign bodies were removed from area adjacent to the fourth ventricle at secondary surgery. There is considerable dilatation of the posterior body and horn of the right lateral ventricle, with moderate enlargement of the third and marked enlargement of the fourth ventricle. There is no significant shift of the system. Arachnoid pathways are obliterated in the cerebellar area and over the posterior cerebrum. The cisternae are markedly dilated.

*Diagnosis:* Postoperative hydrodynamic compensation with ventricular dilatation posteriorly. Adhesive arachnoiditis, posterior.



Fig 9 Case 10 28 days postoperative. No cerebral tissue loss, 4 × 10 cm left frontoparietal bone defect, ventricular dilatation, minimal shift of ventricles contralaterally. Subarachnoid pathways on the left are obliterated.

*Diagnosis:* Mass lesion left. Subdural hematoma. Arachnoiditis left.

closure of the dura at the time of operation did not appear to be an important factor. It is of note that marked ventricular distortions occurred with small bone defects and in the presence of a tightly sutured dura or dural graft.

Since all of these patients had sustained definite brain injury, mainly severe, and were from a previously healthy group of young males, it would seem reasonable to exclude unrelated pathologic conditions in an appraisal of the pneumoencephalographic findings. Osmond (1) reviewed the literature and presented theories and evidence of Winkelman, Gray, Osnato and Giliberti, Penfield,

Grant, Dyke, and others, to explain the pneumoencephalographic findings in post-traumatic conditions of the brain. The presence of dilatation of the ventricular system following "closed" cranial injury has been repeatedly demonstrated. The mechanism remains controversial. The pronounced degree of dilatation in several of this group soon after débridement of brain tissue leaves little doubt that it was on the basis of hydrodynamic compensation. A definite volume of brain tissue had been removed and the space was filled first by fluid or swollen brain substance and later by the ventricles dilated as a result of the positive pressure of the cerebrospinal

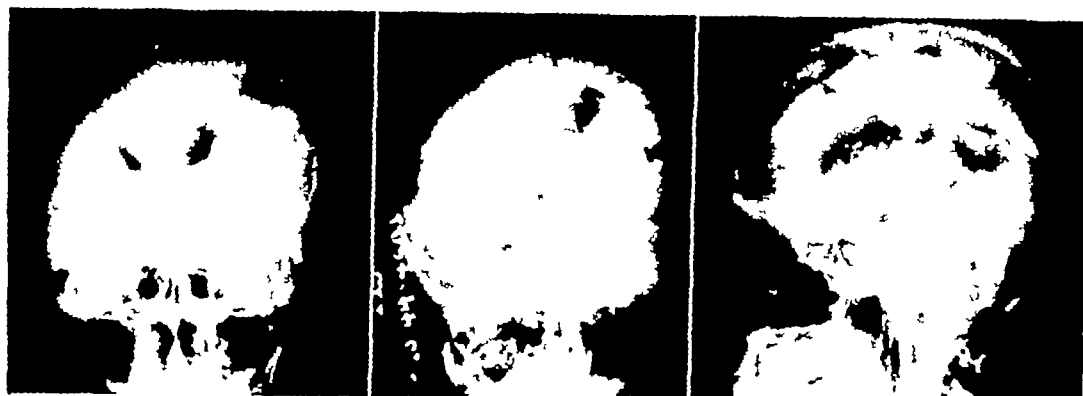


Fig 6 Case 7 61 days postoperative Penetrating wound with bursting type of fracture Degree of cerebral tissue loss at debridement was not clearly defined in early records Bone defect  $3 \times 3$  cm in addition to defects produced by separation of bone fragments of fractures involving right frontal, parietal, and occipital areas

Moderate dilatation of right lateral ventricle is noted, with slight enlargement of left lateral and third ventricle. No shift is present Subarachnoid pathways are obliterated on the right Cisternae slightly dilated

Diagnosis Postoperative hydrodynamic compensation with ventricular enlargement Adhesive arachnoiditis right

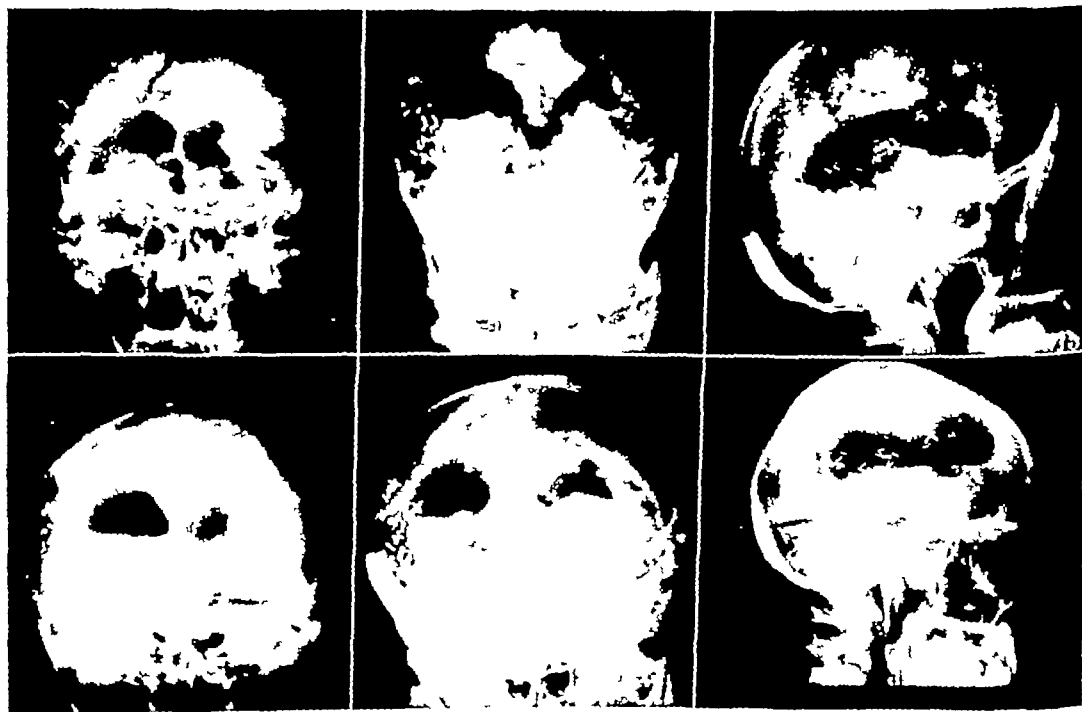


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The three upper views, made 14 days postoperative show severe cerebral tissue loss bone defect  $10.5 \times 3.5$  cm right parietal Moderate dilatation of right lateral ventricle is present No significant shift is present Subarachnoid space obliterated over right side and decreased on left

The three lower views were made 71 days postoperative The progression in the enlargement of the right lateral ventricle is illustrated, with generalized ipsilateral shift Subarachnoid space not visualized

Diagnosis Postoperative hydrodynamic compensation with marked ventricular enlargement and slight shift Adhesive arachnoiditis

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drodynamic changes (2) Convulsions were also infrequent during the early phase or period, three months following operation. Of the 119 patients having dural penetrations in the first group, 14 had generalized or jacksonian convulsions. In 5 of this group the convulsions occurred after evacuation of complicating brain abscesses. All patients were given routine phenobarbital suppression therapy.

Late roentgen changes following penetrating wounds of the brain must be studied after the return of these patients to hospitals in the zone of the interior. In view of the early findings observed, it seems reasonable to predict that a further progression of ventricular dilatation will occur as a result of such factors as cerebral atrophy, cicatrix, arachnoid abnormality, and the bone defect.

#### SUMMARY

1 Twenty-three pneumoencephalographic studies of patients from a group of 256 with penetrating cranial wounds are reported.

2 Following loss of cerebral tissue, an enlargement of the ipsilateral ventricle was usually observed. When the loss of tissue was great, the contralateral ventricle also dilated and the ventricular system shifted to the affected side. The ventricular enlargement was usually proportional to the tissue loss.

3 Ventricular enlargement occurred at an early period following primary débridement.

4 Arachnoiditis was a common finding.

5 The influence of cerebritis, arachnoiditis, and the bone defect on later changes is postulated.

1420 St Antoine  
Detroit 26, Mich

#### REFERENCES

1 OSMOND, LESLIE H. Correlation of Disability with Roentgen Findings. Head Injuries. Radiology 41: 1-10, July 1943.

2 PANCOAST, H. K., PENDERGRASS, E. P., AND SCHAEFFER, J. P. The Head and Neck in Roentgen Diagnosis. Springfield, Ill., Chas. C. Thomas, 1940.

*Note.* Bibliography is of necessity limited due to lack of available reference material under conditions of army field operation.







Fig 10 Case 11 63 days postoperative There was severe loss of cerebral tissue and the bone defect was of moderate size (4 cm in diameter) There is no ventricular dilatation or displacement Subarachnoid pathways are obliterated only around the bone defect

*Diagnosis* Localized adhesive arachnoiditis Otherwise normal encephalogram

*Note* This was the only patient in the series with severe cerebral loss who showed normal ventricular pattern

fluid The ipsilateral shift of the system is evidence of further compensation Similar findings have been observed following the removal of brain tumors When contralateral shift was demonstrated, it was suggestive evidence of a mass lesion, complicating the original trauma (four instances—see Figs 1 and 2 and 9)

Contamination of the subarachnoid pathways undoubtedly occurred in the 206 cases of dural penetration In many, infection was controlled immediately and little arachnoiditis or cerebritis developed In others, the infection progressed to produce meningitis, either local or generalized Both acute and chronic basilar meningitis with mechanical blocking of the normal pathways of cerebrospinal fluid outflow occurred in several patients This phenomenon may be a factor in subsequent diffuse enlargement of the ventricular system

Cicatrices in the cerebrum could not be evaluated as a factor in producing the distortion seen in this early phase The presence of strictly localized protrusions was not significant

The progression of the ventricular dilatation in Cases 1 and 8 (Figs 1 and 7) would seem to indicate the future course in

many of these cases The primary phase of change may be arbitrarily considered as that occurring during the first few months following injury During this period the hydrodynamic effect is largely a mechanical factor compensating for the loss of cerebral tissue Cerebral damage also has occurred, which may later contribute to atrophy and cicatrix formation resulting in slow but progressive dilatation The common finding of localized or generalized adhesive arachnoiditis indicates a disruption of the normal cerebrospinal fluid elimination mechanism, which is of significance

Although a number of brain wounds communicated with the ventricle, resulting persistent loculation of cerebrospinal fluid in the cavity created at operation did not develop

Evidence of cerebral atrophy and porencephaly was absent, with possibly the exception of a small porencephalic cavity associated with the lateral ventricle in one case

Two related clinical aspects of the postoperative period should be briefly mentioned (1) Headache was uncommon in the uncomplicated wounds in spite of hy-

drodynamic changes (2) Convulsions were also infrequent during the early phase or period, three months following operation. Of the 119 patients having dural penetrations in the first group, 14 had generalized or jacksonian convulsions. In 5 of this group the convulsions occurred after evacuation of complicating brain abscesses. All patients were given routine phenobarbital suppression therapy.

Late roentgen changes following penetrating wounds of the brain must be studied after the return of these patients to hospitals in the zone of the interior. In view of the early findings observed, it seems reasonable to predict that a further progression of ventricular dilatation will occur as a result of such factors as cerebral atrophy, cicatrix, arachnoid abnormality, and the bone defect.

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# Scout Film of the Abdomen<sup>1</sup>

LT COL JOSEPH LEVITIN, M C, A U S

A "SCOUT FILM" of the abdomen is one obtained without the use of a contrast medium or any preparation on the part of the patient. Such an examination is usually an emergency procedure and is often done at the bedside. That it has not received the recognition it deserves is the fault of the roentgenologist, who has not brought its value as a diagnostic aid in acute abdominal conditions to the attention of the surgeon. Upon the former it makes special demands. Used to regular hours and "Sundays off," he is too often not available for an emergency x-ray examination. These acute cases, however, do not choose their time of entry, they are as likely to come in after hours or on a week-end as at a more convenient time. Unless the roentgenologist is prepared for emergency calls, he will not cultivate "x-ray mindedness" on the part of the surgeon. On the other hand, if he is prepared for such inconveniences as are entailed, he will be well rewarded by the satisfaction of a diagnosis well made and the knowledge that a life-saving procedure was due in great part to his co-operation.

Most acute conditions of the abdomen have a well established history, with well known physical findings. It is not with such cases that this paper is concerned, though they may require an x-ray examination to substantiate the diagnosis. It will deal, rather, with the obscure case, in which the history is unsatisfactory, or physical findings are inadequate, and further aid in diagnosis is required.

We have found a "scout film" of the abdomen of significant aid in substantiating or establishing a diagnosis in the conditions discussed below.

*Perforated Ulcer* The diagnostic value of the demonstration of free air in the abdo-

men, between the liver and diaphragm, in the upright film as an indication of a perforated ulcer is well known (Fig 1). An additional anteroposterior view in the lateral decubitus position, with the left side down, is desirable and as a sole view is to be preferred. This view can easily be made at the bedside and, in one instance has shown the air where the upright view failed (Fig 2). While the condition of the patient may be such that an upright film is difficult to obtain, it is easy for him to roll on his left side for a lateral decubitus view. Another advantage of the lateral decubitus position is the avoidance of a possible error which once occurred, when a diagnosis of a perforated viscus was made on a right-sided stomach. The normal gas-bubble was mistaken for free air in a patient with acute abdominal pain. A lateral decubitus film would have prevented that error.

*Non-Opaque Ureteral Stone* Although strictly speaking the diagnosis of a non-opaque ureteral stone is not made without further x-ray examination, the condition may be included here. The abdominal findings are important in a negative sense, in that no abnormal bowel dilatation may be present. If the stone is on the right side, a clinical differentiation of ureteral colic from an acute appendicitis may prove difficult. Such a stone may block the ureter and as a result the characteristic finding of blood in the urine may be absent. An intravenous pyelogram can be made without upsetting the patient. If necessary, the films can be taken at the bedside with the aid of a stationary grid. The significant finding for a diagnosis of a stone in the ureter is the anuria which may be present on the affected side, while the opposite side shows normal excretion.

<sup>1</sup> Material gathered from civilian practice, Mt Zion Hospital San Francisco prior to entry into the Army. Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America Chicago, Ill, Sept 24-29, 1944.

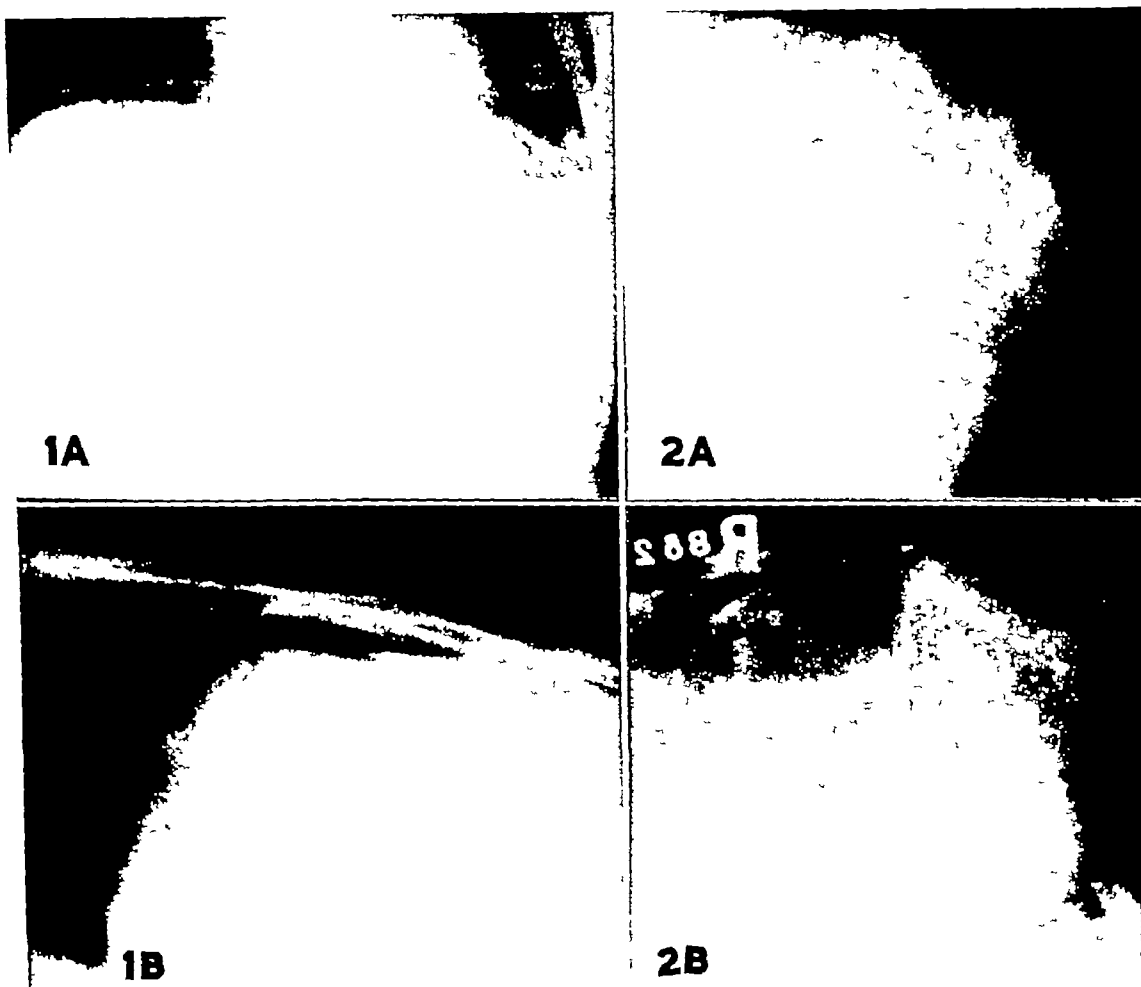


Fig 1 Perforated ulcer A Upright film of abdomen demonstrating free air beneath the diaphragm B Lateral decubitus view of abdomen with patient lying on the left side, demonstrating free air in the peritoneal space between the liver and thoracic cage

Fig 2 Perforated ulcer A Upright film of abdomen No air is demonstrated B Lateral decubitus view of abdomen showing a small amount of air in the peritoneal space between the liver and thoracic cage This view is preferred

There may be failure to excrete the dye on the side of the stone, due to spasm of the kidney pelvis. The kidney on the affected side appears increased in density because of the dye in the tubules. This finding is sufficient for diagnosis of non-opaque stone in the ureter (Fig 3). It must be borne in mind that both kidneys may not excrete the dye at the same time, and repeated films must be taken until all the dye is excreted before the conclusion is reached that one side fails to function. If the involved side should excrete the dye, dilatation of the ureter above the calculus is diagnostic of a block.

*Ileus, Small Bowel Distention* Before undertaking a discussion of small bowel distention, we must first have an understanding of the normal and a clear conception of the dynamics of the bowel and physiological changes. This knowledge we must translate into a mental picture of the bowel (1). Only so can we evaluate the changes we may see on the film. A clear knowledge of the origin and importance of the gas in the bowel must be had, since it is the gas-filled intestinal loops that give the clue to the diagnosis.

The normal film of the abdomen may show gas in the stomach, duodenal bulb,

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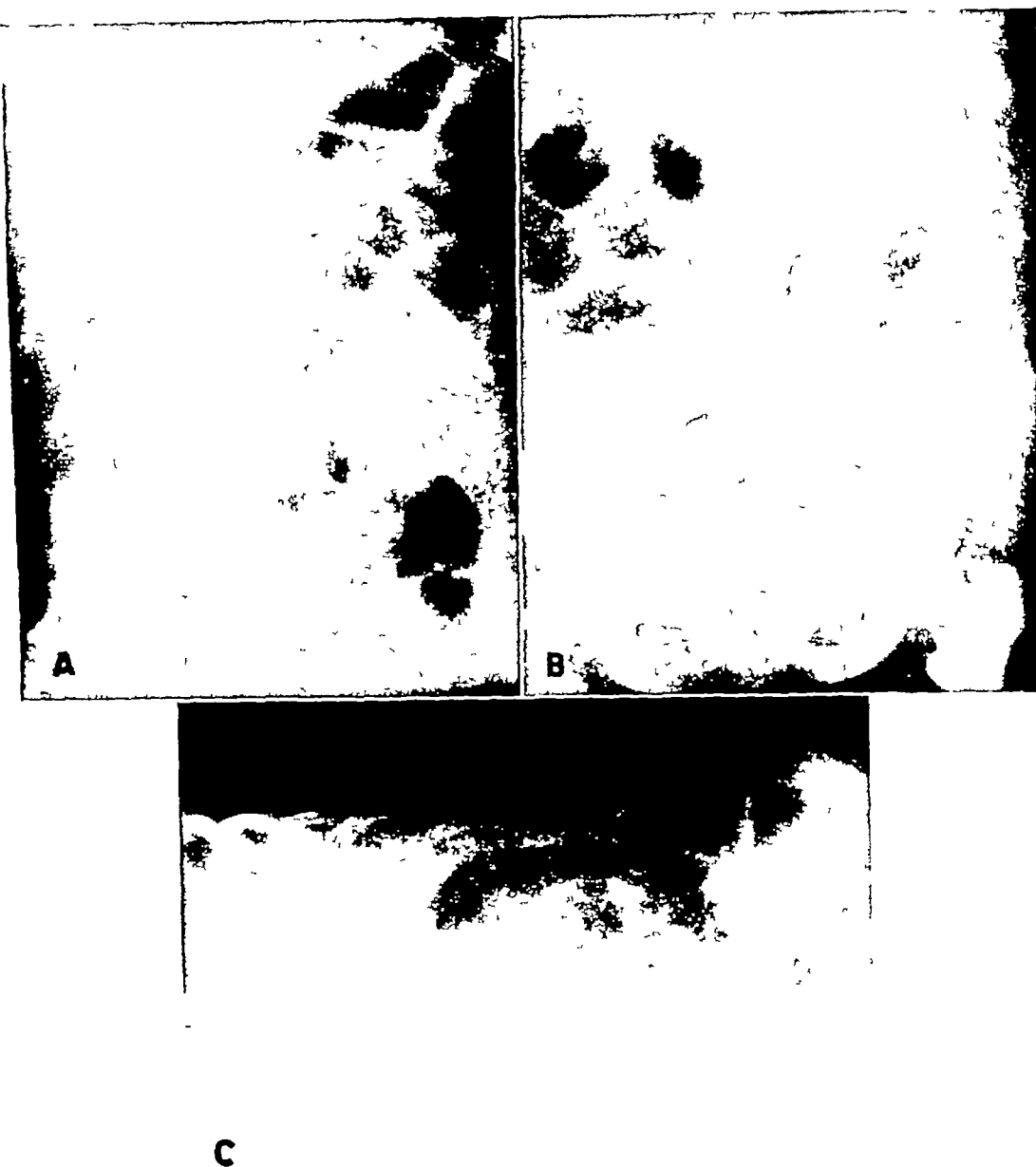


Fig 5 Mechanical small bowel obstruction. A and B Anteroposterior views in prone position. There is a continuous distention of the small bowel, which is markedly dilated. The coils tend to be horizontal, with sharp hair-pin turns, giving so-called "step-ladder" appearance. A short interval elapsed between views A and B. Note different arrangement of the loops. The bowel is active, "dynamic." C Lateral decubitus view with right side up. Fluid in the bowel can be seen only with the patient in this position or upright, as the X-ray must be directed horizontally. The gas in the bowel rises and fluid settles, so that the fluid in all the loops of bowel tends to be in the same horizontal plane. Gas is seen in the colon, which lies in the flank at right angles to the distended small bowel. The colon is of normal size, whereas the small bowel is distended. The gas in the distended loops is greater in vertical diameter than in the transverse

is innervated by sympathetic and parasympathetic fibers. The former inhibit while the latter stimulate peristalsis. Stimulation of the sympathetic fibers or inhibition of the parasympathetic will result in cessa-

tion of peristalsis. Intestinal absorption takes place within the numerous villi lining the surface of the small bowel. The constant change in shape of the villi with intestinal peristalsis provides new surfaces



Fig 3 Non opaque stone in the left ureter. Normal excretion of dye on the right. No excretion on the left side.

and colon, gas in the small bowel is abnormal except in infants. There are three sources of gas in the bowel. 68 per cent is swallowed air, 22 per cent is due to diffusion from the blood stream, 10 per cent is the result of digestive fermentation (2). The swallowed air seen in the stomach is broken into small bubbles in the jejunum and carried in solution with the intestinal contents. Interference with the normal passage of the latter will affect the gas held in solution, it will be thrown out of solution and be seen on the film. There are two abnormal situations in which gas will be found in the small bowel. One is a paresis of the bowel, in which there is lack of peristalsis. This is a paralytic (or adynamic) ileus. The other is a mechanical block in the lumen—mechanical or dynamic ileus. If we keep in mind the underlying cause of each and apply that information to the interpretation of the films, we can distinguish the two types, as they give a different picture (3).

*Paralytic or adynamic ileus* represents a reflex inhibition (2). The intestinal tract

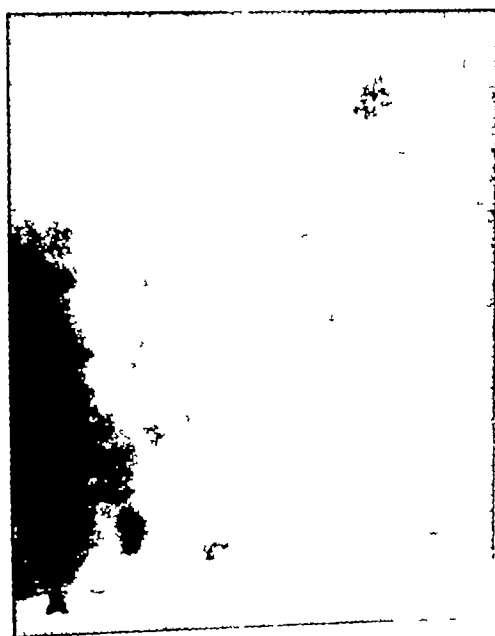


Fig 4 Paralytic ileus. A Anteroposterior view in prone position. There is a moderate distention of both the small and large bowel. The small bowel distention is of a segmental nature, i.e., not one continuous loop. B Lateral decubitus view, patient lying on left side. There is free movement of the loops. All the gas rises so that there is one horizontal fluid layer in the multiple loops of distended small bowel. The loops are shallow, the horizontal diameter of the gas collections tending to be greater than the vertical diameter.

for absorption. With cessation of peristalsis, no new surfaces are exposed, the gas present is no longer held in solution, and is evident on the film. Since the nerve supply is the same to the small and large bowel, gas will be seen scattered throughout both, and they will be distended in the same relative proportion. The distended loops in paralytic ileus do not reach the size of those of mechanical obstruction. The gas-filled loops in the small bowel and the colon are not continuous, but small scattered loops are present. There is, however, a free flow of intestinal contents between them, as can be seen by a film taken in the lateral decubitus position. The gas all rises so that the fluid levels in the various loops are in the same horizontal plane (Fig 4).

Paralytic ileus is responsible for the distention which follows abdominal surgery. In an x-ray study of the abdomen in post-operative cases its incidence was found to be 75 per cent (4). It was present immediately following surgery, disappearing on the third to the fourth postoperative day. It is at the time of disappearance of this paralytic ileus that the patient complains of "gas pains," which are probably due to resumption of peristalsis. Paralytic ileus is also the type that follows emotional disturbances such as fear, fright, and pain. It is an annoying accompaniment of instrumentation during cystoscopy and often obscures the pyelogram. It is found in spinal cord injury and severe fractures of the extremities. It is not a serious condition. The usual therapy of flushes and peristaltic stimulants do not affect its course. Spinal anesthesia to block the sympathetics may relieve the distention and bring about a restoration of peristalsis. Fatal sequelae do not follow, but differentiation from the more serious mechanical obstruction of the small bowel, which does require immediate therapy, is important. A localized paralytic ileus is also found with inflammatory lesions within the abdomen. This will be discussed later.

*Mechanical obstruction* results from an interruption of the free flow of intestinal



Fig 8 Small bowel mechanical obstruction by gallstone in the terminal ileum

contents. The block may not be complete, but, whether it is complete or incomplete, changes will be found on the x-ray film. The causes of mechanical obstruction are numerous. Included among them are new growths, cicatrizing enteritis, adhesions which kink or compress the bowel, volvulus,





Fig 6 Mechanical small bowel obstruction A Anteroposterior view in prone position Continuous distention of small bowel The small bowel lies in the middle of the abdomen The lower loops of ileum are usually smooth B Lateral decubitus view with left side down C Lateral decubitus view with right side down There is free movement of the loops of distended bowel With change in position, the gas all tends to rise and the fluid to settle in the most dependent portion, resulting in a single horizontal fluid level The colon is seen distended with gas in these views, but is of normal size, whereas the ileum is distended. Note also the sharp hair-pin turns in the small bowel

Fig 7 Mechanical small bowel obstruction The valvulae conniventes which give the 'herring-bone' or 'coiled-spring' appearance to the small bowel, are unusually prominent They diminish in number as we go down the ileum They are better seen in the lateral decubitus position

as due to afferent impulses from the distended bowel, producing vomiting and fall of blood pressure X-ray examination of the abdomen should be done early in every case of distention where possibility of a mechanical bowel obstruction is present One should not wait for collapse to institute treatment or to make the diagnosis, since that may not occur until late in the course Treatment to relieve the distention should be instituted as soon as a diagnosis is made by x-ray The fact that a patient has a bowel movement does not exclude obstruction The bowel distal to the obstruction will continue to evacuate its contents

If we go over the stages of a mechanical obstruction, we can easily visualize the appearance on the x-ray film When obstruction occurs, the proximal bowel dilates There is an interference with absorption, and the gas present in the intestinal contents is thrown out of solution To overcome the obstruction, peristalsis becomes vigorous, the loops shorten and widen, and in films taken at brief intervals appear in different arrangements (Fig 5) In rearranging themselves, they take the shortest course in the abdomen, which is transverse One continuous loop of gas may be seen extending to the obstruction Distal to the obstruction there is no gas and usually no gas is to be seen in the colon Even if gas should be present in the colon, as it sometimes is in patients who have received an enema just before entering the hospital, there will be no unusual distention This is different from the findings in paralytic ileus, in which the colon and small intestine are equally distended In mechanical obstruction, distention is limited to the bowel proximal to the obstruction Another difference is the continuous distention of the small bowel in mechanical ileus and the segmental distention in the paralytic type

The appearance of the bowel itself also differs in the two conditions In the paralytic bowel the loops are shallow, in the presence of mechanical obstruction they are large and dark and are greater in the

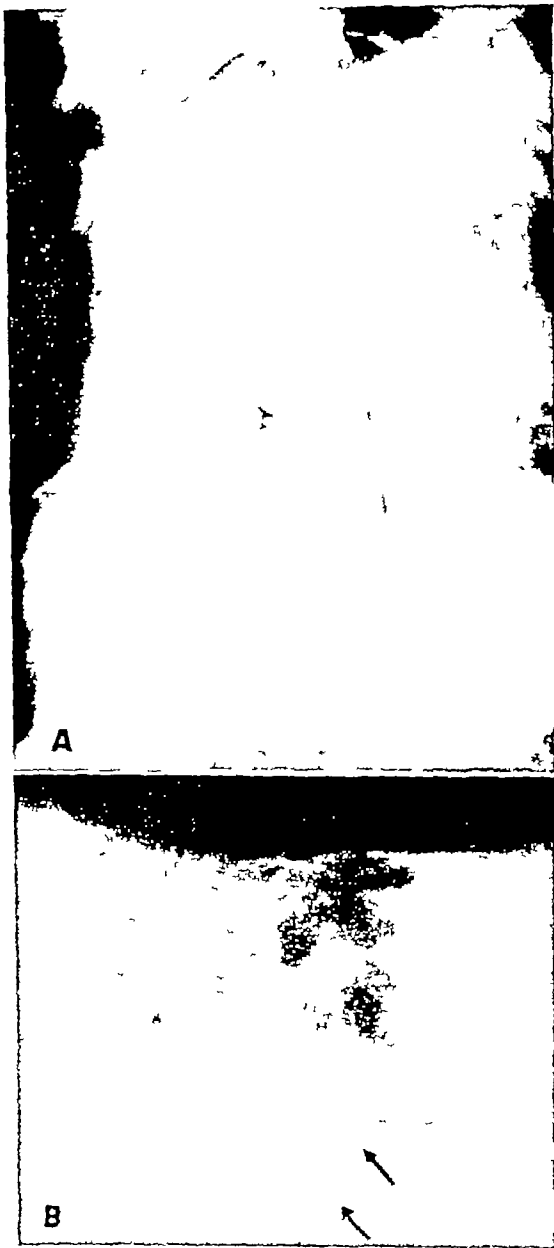


Fig 10 Peritonitis A Anteroposterior view in prone position Distended loops of small bowel in left side of abdomen The appearance of the bowel is that of mechanical obstruction The underlying condition cannot be appreciated in this view Upright or lateral decubitus views are necessary B Lateral decubitus view with right side up Multiple loops of small bowel are seen in the lower left side, fixed in position, resulting in multiple fluid levels The loops are shallow, greater in transverse diameter than vertical, characteristic of paralytic ileus The large distended loops in the right upper quadrant are distended stomach and gas in the colon The properitoneal fat line is obliterated but this is not well demonstrated on the reproduction

vertical diameter than the transverse (6) In mechanical obstruction the circular folds

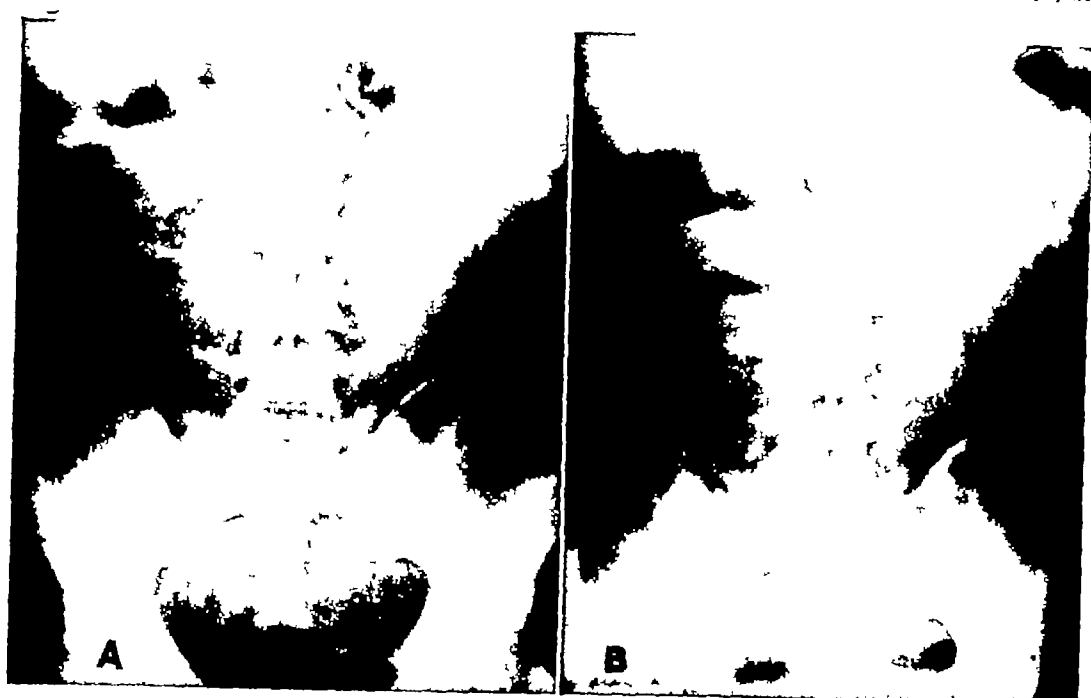


Fig 9 Peritonitis A Anteroposterior view in prone position Distended loops of small bowel The true nature of the underlying condition is not appreciated in this view Films must be taken with the x-ray directed horizontally B Upright view The loops of small bowel are fixed in position giving multiple horizontal fluid layers The loops are shallow, greater in transverse than vertical diameter, characteristic of a paralytic bowel The proctocolic fat line is obliterated but this is not well demonstrated on this reproduction

lus, intussusception, and unreduced hernia, both internal and external A localized infection such as an appendiceal abscess may cause local spasm, which halts the progress of the intestinal contents, or the fibrin of the localized peritonitis may cause adherence of loops of small bowel producing an acute angulation Mechanical small bowel obstruction has been caused by an impacted gallstone at the ileocecal valve, and by tumor, such as lymphoblastoma, at the terminal ileum An ingested foreign body perforating the small bowel, causing a local irritation, has also resulted in a mechanical obstruction An unusual case was one in which the small bowel became adherent to a perforated bladder The bowel was acutely angulated and mechanical obstruction resulted Edema of the bowel caused by low plasma protein concentration may also result in obstruction (5) Mechanical obstructions must be differentiated from paralytic ileus, because if unrecognized and untreated they may prove fatal If, however, diagnosis is

made early and proper treatment is instituted—the most important measure being decompression of the bowel—fatalities can be avoided

An important fact which is not generally appreciated is that an almost complete low small bowel mechanical obstruction can exist for some days with minimal or no symptoms This was mentioned as early as 1921 by Kloiber (6), who found 9 cases with a positive x-ray diagnosis but without clinical symptoms in a series of 77 examinations Indeed, the patient's appearance may belie the seriousness of his condition In a daily follow-up postoperative study by x-ray examination, two patients were found to have a low small bowel mechanical obstruction Although the films showed progressively increasing distention, there were no complaints or physical signs of obstruction until the tenth and eleventh day, respectively At that time there was a sudden collapse, with nausea, vomiting, increased pulse rate, and increased respirations Such collapse has been explained (7,

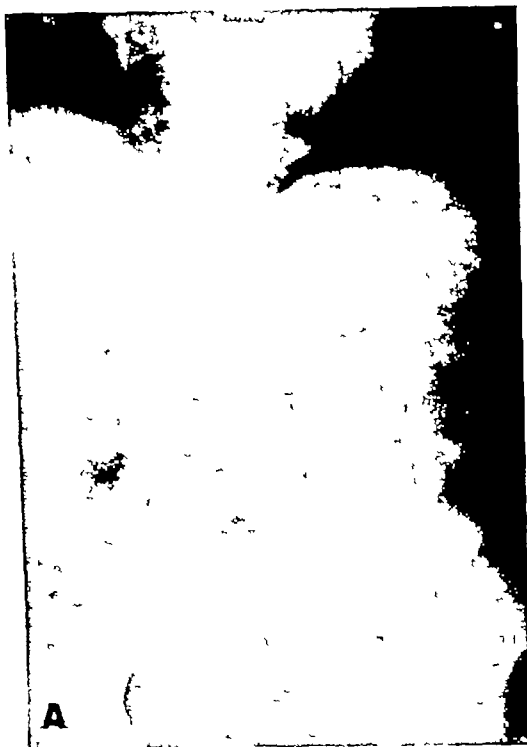


Fig 14 A Perforated diverticulitis with localized abscess. Anteroposterior view in prone position. There are several loops of distended small bowel in the left side of the abdomen, above the iliac crest.

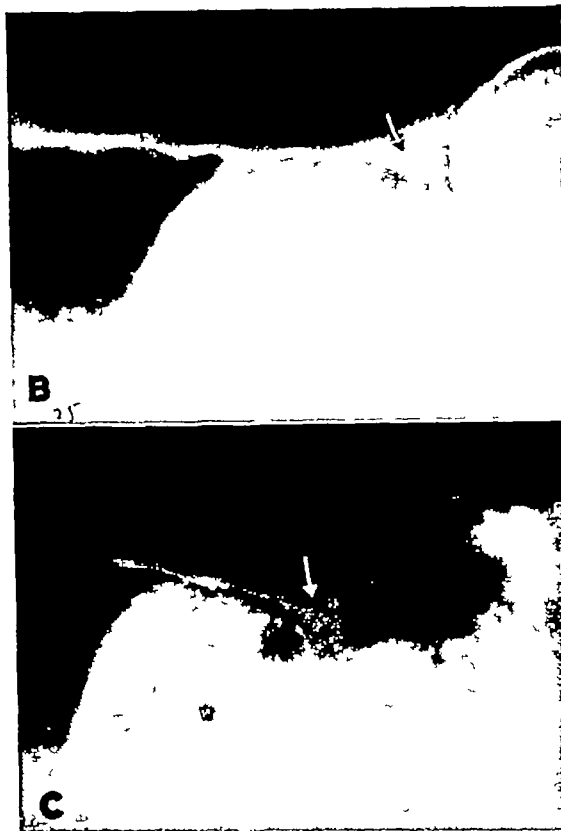


Fig 14 B and C Same case as shown in 14, A, B Lateral decubitus view with right side up. Gas is seen in the cecum and ascending colon. Note the properitoneal fat line, which is represented by a dark stripe in the flank, parallel with the colon. There is a differentiation between the properitoneal fat, the muscles, and the subcutaneous fat. C Lateral decubitus view with left side up. The properitoneal fat line is lost. The differentiation between layers of muscle and fat is lost. The soft-tissue shadows of the flank are enlarged as compared to the normal. Some loops of small bowel are seen in the neighborhood.

are prominent, giving an impression of a spring ready to uncoil, and there is marked contrast between the gas-distended bowel and the rest of the film. The coils have sharp hair-pin turns and as a result of peristalsis some will be indistinct. As pointed out above, vigorous peristalsis is present, so that successive films show different arrangements of the loops. There is free communication between the loops of bowel, as is the case, also, in paralytic ileus. This is well shown in films made in the lateral decubitus position. The gas rises, the loops re-arrange themselves, and the fluid all tends to lie in the same horizontal plane. This fluid is not demonstrable in the supine anteroposterior view. It can be shown only by a horizontally directed ray with the patient in the lateral decubitus position or upright (Fig 6). With release of the tension within the lumen of a mechanically obstructed bowel, either by Miller-Abbott tube or surgery,

there is a prompt return to normal. There is no loss of tone. If x-ray examination continues to show distended bowel, an obstruction either has been overlooked or has not been relieved.

It is necessary to recognize the characteristics of the distended small bowel and not to confuse it with the colon if an erroneous diagnosis is to be averted. Starting at the jejunum and diminishing in number in the course of the bowel are the valvulae conniventes, reduplications of mucous membrane containing the villi. The two layers of the valvulae conniventes are bound together by submucous connective tissue.



Fig 11 Acute gallbladder disease Localized loop of distended small bowel ("sentinel loop") present in right upper quadrant on repeated examination (A and B)

Fig 12 Subhepatic abscess Localized loop of small bowel ("sentinel loop") constantly present in subhepatic region The peritoneal fat line is absent, which led to a diagnosis of abscess rather than an acute inflammation

Fig 13 Acute appendicitis Localized ileus ("sentinel loop") in right lower quadrant

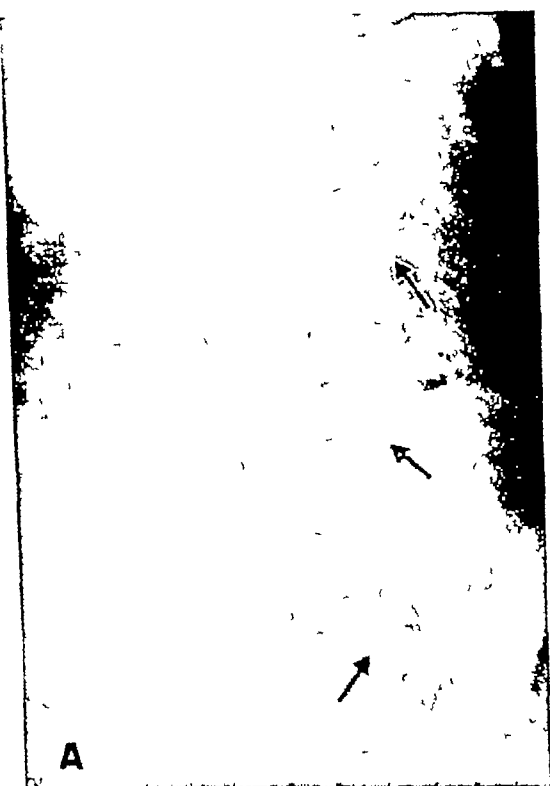


Fig 16 A Intra-abdominal adhesions partial small bowel obstruction Anteroposterior view in prone position Several large loops of distended small bowel in left side of abdomen



Fig 16 B and C Lateral decubitus views of case shown in Fig 16, A, right side up (B) and left side up (C) Note multiple loops of small bowel fixed in position They differ from the fixed loops of peritonitis in that they are not shallow The properitoneal fat line (not well seen on reproduction) is present on both sides History and other clinical findings would differentiate this condition from peritonitis

is a tendency for the loops of small bowel to become adherent by plastic exudate and fixed in position. These fixed loops can best be seen on films made in the upright or the lateral decubitus position. Instead of gas rising to the upper level, producing a horizontal fluid level, as in mechanical and paralytic ileus, we see fixed loops scattered through the abdomen, with fluid at various levels (Figs 9 and 10). With the persistence of peritonitis, the mechanical dynamic bowel becomes a paralytic adynamic bowel, as the result of the inhibitory impulses due to irritation of the peritoneum (8). The bowel now is shallow, the transverse diameter greater than the vertical.

Another sign may be present which signifies exudate in the abdomen, though absence of the sign does not exclude the occurrence of an exudate. This is the appearance of the properitoneal fat line. The peritoneum is lined with endothelium,

next to which is a layer of fat demonstrable on properly exposed films<sup>2</sup> as a dark stripe. Exudate may infiltrate the fat so that it is not visible on the film. This sign is most important in the diagnosis of localized abscess, which will be discussed below.

To recapitulate, a diagnosis of generalized peritonitis can be made in the presence of distended loops of small bowel fixed in position, usually of a paralytic nature, seen in the lateral decubitus or upright films, fluid between the loops of bowel, and obliteration of the properitoneal fat line.

*Inflammatory Lesions and Localized Abscess* An inflammation may cause a localized ileus. The physiological basis for

<sup>2</sup> Such films are taken with a bedside unit, about 60 kv, 25 ma sec 30 mm aluminum filter, to avoid burning out of the flank.



Fig 15 A Intra abdominal adhesions partial small bowel obstruction Anteroposterior view in prone position Distended loops of small bowel in the left side of abdomen

These folds are permanent, running at right angles to the long axis, and cannot be obliterated no matter how great the distention. The undistended bowel is smooth, but when distention occurs these circular folds become prominent, producing a "hering-bone" or "coiled-spring" appearance. The lower ileum is usually smooth (Fig 7).

If the obstruction is high, vomiting will be an early symptom. Toxemia and death may follow from loss of chlorides and fluid. With low obstruction, vomiting will be late. As soon as the bowel distends from the accumulated gas, there is an interference with absorption. A vicious cycle is started. Gas produces distention. Distention interferes with absorption, so that more gas and fluid accumulate. Fluid also accumulates as a result of increased activity of the glands of the bowel. The bowel shortens, giving less absorptive sur-



Fig 15 B Lateral decubitus view of case shown in 15, A, with right side up. Note fixed loops of small bowel with fluid level to right and left of spine. The properitoneal fat line is also well seen.

face. All this tends to increase pressure within the lumen, which is the important factor in the fatal turn of events.

In the upper ileum the venous channels lie primarily beneath the muscular coat, but in the lower ileum they are mostly submucous. With an increase in intraluminal pressure, the latter veins are easily collapsed. The arteries continue to pump blood, but the veins cannot return the flow. The blood finally seeps through into the lumen of the bowel, adding to the pressure. Pressure necrosis, gangrene, and perforation of the bowel wall follow, with a resulting peritonitis.

Mechanical small bowel obstructions are frequently overlooked following surgery. Postoperative distention is too often attributed to paralytic ileus when the underlying cause is a mechanical obstruction. It may be due to an overlooked adhesive band, an internal herniation, fibrin binding together two loops of bowel, or adherence of a loop of bowel to a raw surface of the peritoneum not properly peritonealized.

**Peritonitis** Peritonitis may first show up on the x-ray film as a mechanical obstruction. Fibrin may bind two loops of bowel together, causing an acute angulation and obstruction. Exudate in the abdomen may make its presence known by increased density between the gas-filled loops. With spreading peritonitis, there



Fig 19 A Acute appendicitis, localized abscess with a small bowel mechanical obstruction Anteroposterior view in prone position There is a continuous dilatation of all the small bowel, of a mechanical nature

single loop of distended ileum may persistently be present This is aptly called the "sentinel loop" With abscess formation, an additional sign may be observed The properitoneal fat becomes infiltrated by pus or is edematous (9) Abscesses deep in the pelvis, or covered with omentum so that they are not adjacent to the peritoneum, will fail to give the sign of obliterated properitoneal fat line (Figs 11-14)

**Intra-Abdominal Adhesions** Adhesions within the abdomen can be present without any discomfort to the patient At times loops of small bowel may be caught and become partly obstructed The obstruction may go on to a complete vascular occlusion and gangrene It is only at the time of obstruction that symptoms appear, usually in the nature of cramp-like pain A "scout film" may give evidence of such partial obstruction, but it must be taken at the time symptoms are present Distended loops of small bowel which

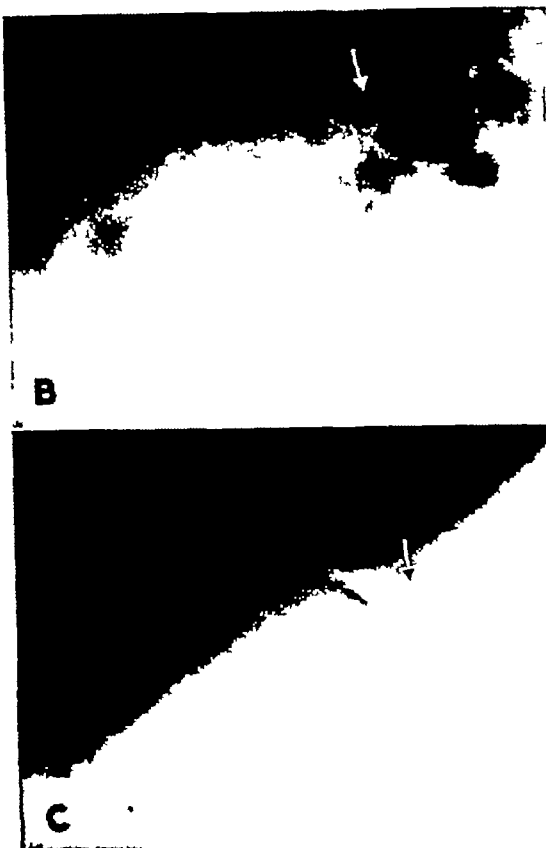


Fig 19 B and C Same case as Fig 19, A B Lateral decubitus view, right side up The right lateral wall is swollen and the properitoneal fat line is obliterated Soft tissue differentiation is lost C Lateral decubitus view left side up The left lateral wall is normal with properitoneal fat line present

remain relatively fixed in position are demonstrable on films in the prone, upright, and lateral decubitus positions Between attacks there may be no roentgen findings

Fixed loops of small bowel, as mentioned above, may also be present in localized infection It may not be possible to differentiate between distended loops due to localized infection and those of partial obstruction The absence of the properitoneal fat line is diagnostic of infection, and the history and other findings will easily clarify the two conditions With infection, we have all the characteristic findings of inflammation, *ie*, elevated temperature, high white blood cell count, and local tenderness Partial obstructions due to adhesions are found in patients who are ambulatory, with a vague history of



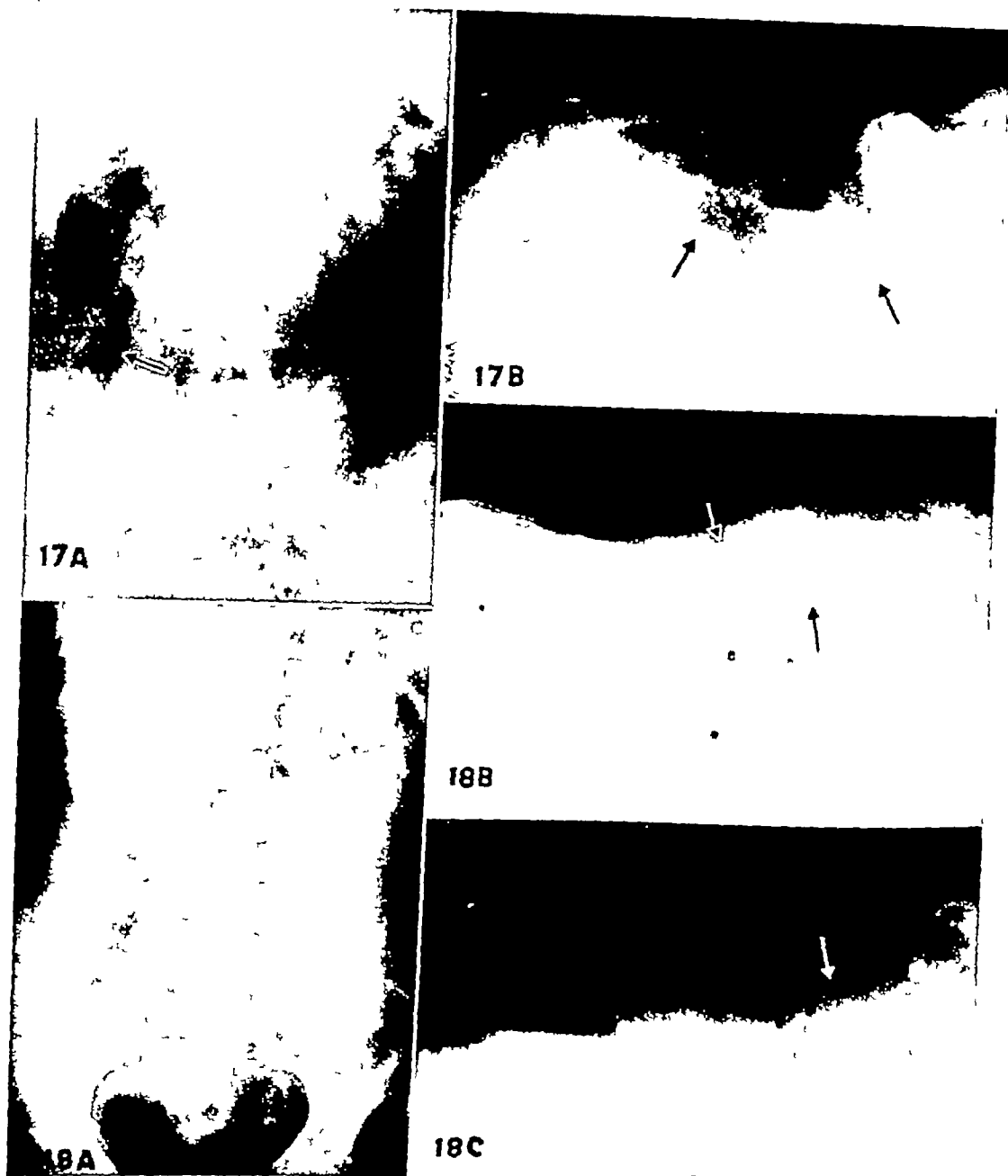


Fig 17 Acute appendicitis, localized ileus A few loops of small bowel are distended in the right lower quadrant (See also Fig 13)

Fig 18 Acute appendicitis, localized abscess A Anteroposterior view in prone position Dilated loops of small bowel are seen The properitoneal fat line is obliterated (compare with C) The abdominal wall has lost the demarcation of the layers of muscle and fat and appears swollen C Lateral decubitus view with left side up The properitoneal fat line is well seen The distended ileum on the right side does not rise, it is fixed in position

this was demonstrated by Alvarez and Hosoi (8), who proved experimentally that irritation of the peritoneum produces an

inhibitory impulse on the digestive tract This is often well seen in acute gallbladder disease and acute appendicitis, when a



Fig 23 Barium enema demonstrating block of hepatic flexure

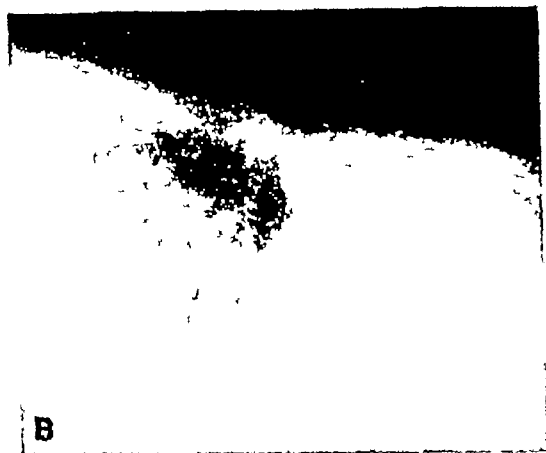


Fig 22 Obstruction to the colon with small bowel dilatation. Distended small bowel of a mechanical nature with distention of the cecum and ascending colon

its entrance into the cecum was the diagnostic feature (Fig 21)

**Obstruction of the Colon** Obstruction of the colon is usually due to carcinoma or volvulus. The differential roentgen findings are based on the difference between a slow-growing obstruction and a sudden one. A carcinoma will cause distention of the bowel proximal to the obstruction and sometimes of the small bowel. The appear-

ance of the latter is that of a mechanical obstruction. Either because of inability of the small bowel to push its contents into the colon on account of increasing cecal pressure, or an incompetency of the ileocecal valve, so that gas is backed into the small bowel, the ileum dilates. Unless attention is paid to the dilatation of the colon, an erroneous diagnosis of mechanical small bowel obstruction may be made. A barium enema should be given whenever there is doubt, since the procedure is harmless inasmuch as the flow of barium is distal to the obstruction (Figs 22 and 23).

A slowly developing obstruction of the sigmoid, which is most always due to carcinoma, can be differentiated roentgenologically from an obstruction due to a volvulus (14). The difference in the findings is based on the fact that with a slow growing obstruction of the sigmoid the colon has a chance to accommodate itself to the increasing pressure. The cecum, having the thinnest wall and the largest diameter of any part of the colon, will

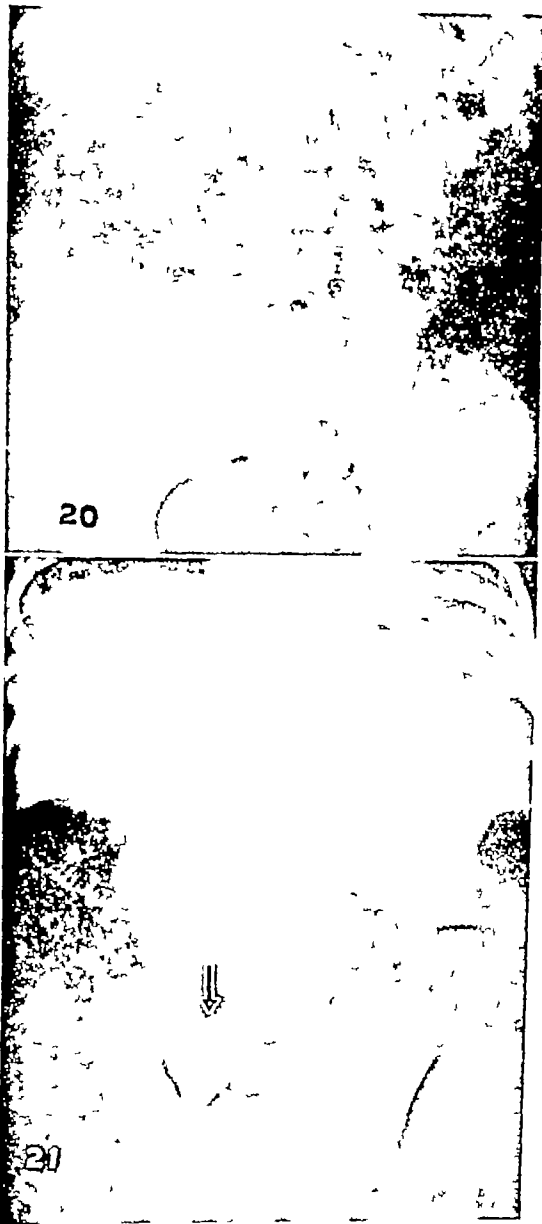


Fig 20 Appendiceal abscess. The properitoneal fat line is absent in the right lower quadrant, the right flank is swollen. The cecum is elevated and displaced medially by the appendiceal abscess.

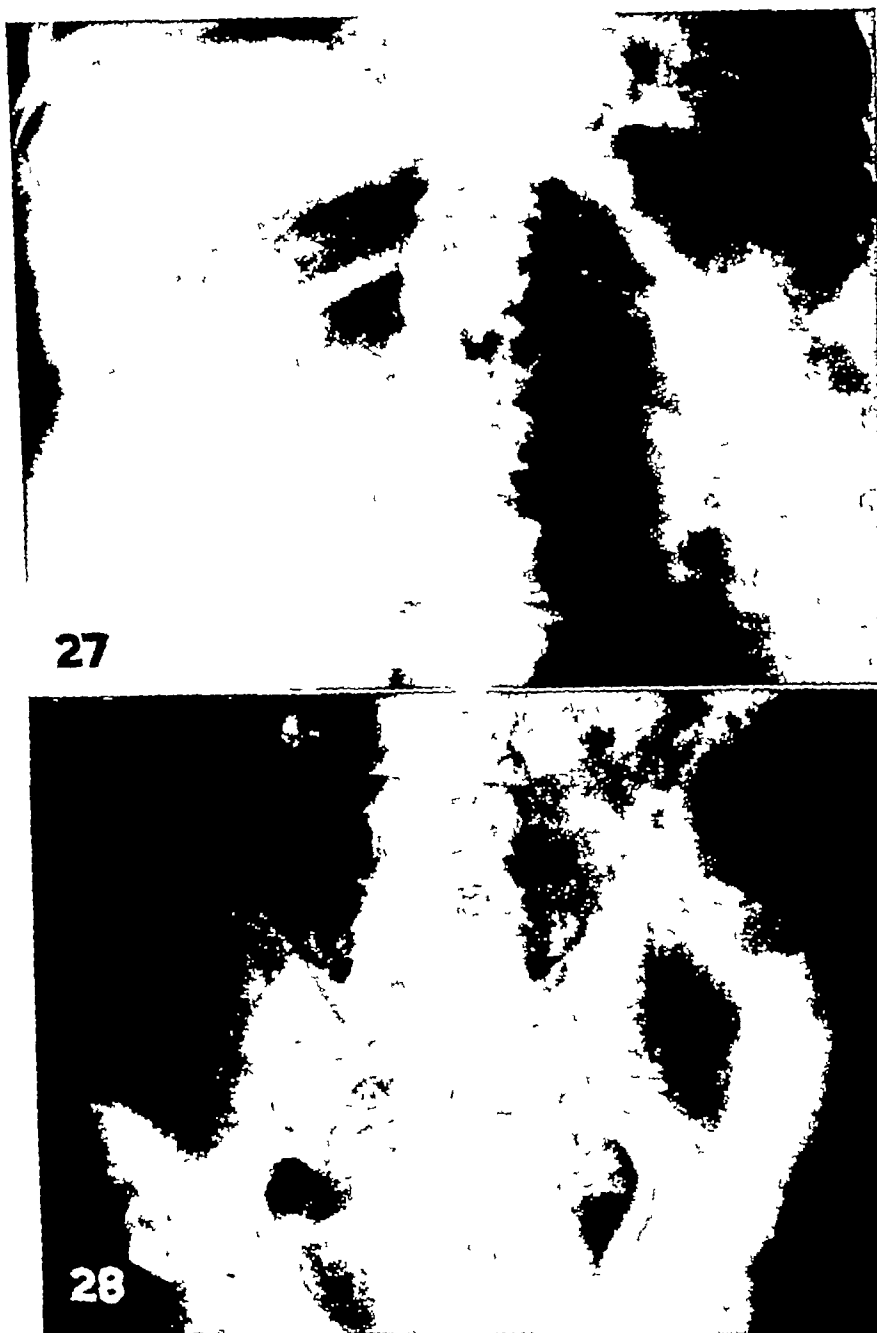
Fig 21 Ileocolic intussusception. Dilated cecum containing within its lumen a second loop of bowel which is narrowed at its entrance into the cecum. The small bowel distal to the intussusception is moderately dilated.

occasional cramp-like pains, a normal temperature and white blood cell count. In the neglected case of mechanical obstruction from adhesions, however, there may be vomiting, elevated temperature and

pulse rate, and increased white cell count, indicating that the single-loop partial obstruction has advanced to a complete obstruction, with possible perforation or gangrene (Figs 15 and 16).

**Acute Appendicitis** The diagnostic criteria of acute appendicitis are so well established and the diagnosis is so often correctly made, that few cases are sent for scout films. Occasionally, however, patients are seen with appendicitis where there is some doubt as to diagnosis. This is especially true in the aged and in children, where the classical syndrome is absent. A sufficient number of "scout films" have been made so that certain features have been found to be present. The findings depend in large part on the location of the appendix and the pathological state when the examination is performed. The pain of acute appendicitis may incite paralytic ileus, a finding which is common to pain whatever the cause. With infection reaching the serosal layer, a reflex stimulation of the sympathetic fibers may cause local ileus (Fig 17). With the presence of exudate about the appendix, the properitoneal fat line may become obliterated in that region, provided the appendix does not lie in the pelvis or is not covered with omentum (Fig 18). With development of an abscess, loops of bowel may become adherent and angulated, resulting in mechanical bowel obstruction (Fig 19). The abscess may elevate and displace the cecum (Fig 20).

**Intussusception** A mechanical bowel obstruction may result from an intussusception, depending on the extent of the narrowing of the lumen by edema of the bowel. X-ray examination by barium enema is advocated by many authors (10, 11, 12) to establish the diagnosis. It has been possible in our experience, on the only two occasions of ileocolic intussusception in which a scout film was taken, to make such a diagnosis without the aid of barium (13). One patient had additional small bowel distention of a mechanical obstructive nature. A distended cecum containing a distended loop of ileum narrowed at



Figs 27 and 28 Sudden obstruction of colon as a result of volvulus of sigmoid. Marked distention of sigmoid. The whole abdomen could not be taken on a single film. A large loop of distended bowel rises out of the pelvis lying in the middle of the abdomen, extending to the diaphragm.

from the point of obstruction to the cecum. The ability to distinguish between the two types of obstruction is most important to the surgeon. If the distention is due to an obstruction of the sigmoid, a decompression of the bowel by a cecostomy may be

the procedure of choice. The right-sided incision required in this instance is obviously not satisfactory for reduction of a volvulus.

*Gangrenous Bowel* Gangrene of the bowel is the one situation where a grave



Figs 24 and 25 Two cases of obstruction of colon by slow-growing carcinoma of sigmoid Distention of colon to the sigmoid



Fig 26 Sudden obstruction of colon as a result of volvulus of sigmoid. Markedly distended sigmoid rising out of the pelvis, lying in the middle of the abdomen, extending to the diaphragm

show the earliest and the greatest distention. It may even be distended to the point of perforation (15). The obstruction may be slowly progressive, producing

intermittent right-sided distress and it may make itself evident by suddenly becoming complete. The patient then becomes acutely ill, with pain, distention, and all the symptoms of an acute obstruction. Films of the abdomen at this time show distention of the colon to the point of obstruction (Figs 24 and 25).

A volvulus of the sigmoid also causes a sudden attack of pain and distention. The twisted loop is suddenly distended to a marked degree. The proximal colon is at first normal, later it, too, becomes distended as a result of mechanical block by the volvulus. Early the distention is limited to the involved loop. The largest distended loops of bowel have been encountered with a volvulus. The single loop may fill the abdomen. The x-ray appearance of the distended sigmoid differs from that of the slowly developing obstruction. The volvulus is seen on the film as a dilated gas-filled loop of bowel rising out of the pelvis and lying in the middle of the abdomen (Figs 26-28). The distended colon due to a gradual obstruction of the sigmoid lies in the usual position for the colon and can be traced

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condition may be present in the abdomen and the x-ray findings be not only disappointing but misleading. Among the causes of gangrenous bowel are mesenteric thrombosis, mechanical obstruction, strangulation of the vascular supply by volvulus, unreduced hernia, and intussusception. Some have reported changes demonstrable by x-ray in strangulation. Hintze (16) states that if an entire coil of small intestine is shut off from the intestinal tract, and the ends are strangulated, the coil will become greatly dilated by gas. Laurell (17) likewise has found typical pictures of intestinal obstruction in embolism and thrombosis of the mesenteric vessels. That has not been my experience or the experience of others (18). It may be that these cases where nothing was found were seen late in the course of the strangulation and that, if films had been taken early, some evidence might have been present. In five cases of gangrenous bowel examined, the involved loop was filled with fluid, but no gas was present, and there was no proximal distention. Although no peristalsis was present in the gangrenous bowel, there was no obstruction to the flow of fluid. The negative x-ray findings—no distention or ileus—may mislead the surgeon into the belief that all is well in the abdomen and operation may be delayed.

From a practical clinical point of view, how much can we tell the surgeon from the scout films that he does not already know, and how great a difference will this make in the procedure employed?

The best indication of the value of the findings on the abdominal film to the surgeon is his increased demand for this examination once the roentgenologist has proved its value and shown a willingness to co-operate. Where the making of an abdominal film was formerly a rare occasion at this hospital, it has now become almost routine for the acute surgical abdominal case. In a previously reported follow-up series (4) it was found that every diagnosis made by x-ray of mechanical ob-

struction was substantiated by surgery, while in no case which was diagnosed roentgenologically as paralytic ileus was mechanical obstruction proved by surgery or the subsequent clinical course.

We may not always be able to tell the nature of the lesion or cause of an obstruction, but we can tell whether an abdomen requires surgical intervention and, as in the case of volvulus, where best to make a surgical approach. A negative diagnosis of paralytic ileus may cause one to look further for the cause of the abdominal pain, as in one case in which additional questioning revealed a history of a black widow spider bite.

Many of the conditions discussed above can exist without x-ray evidence. It may even be necessary to make repeated examinations. Cases with a normal picture on one day have shown a typical mechanical obstruction on the next. The absence of x-ray findings, however, should not discourage the use of this type of examination but should stimulate one to find out why certain signs were not present. The evidence may be there, and the interpretation wrong. Only thus can we add to our information.

Valuable information is present on the "scout film," which requires study and careful interpretation in co-operation with the surgeon. The time spent by the roentgenologist is well rewarded by the growing respect and increasing demand for his opinion by his surgical colleagues.

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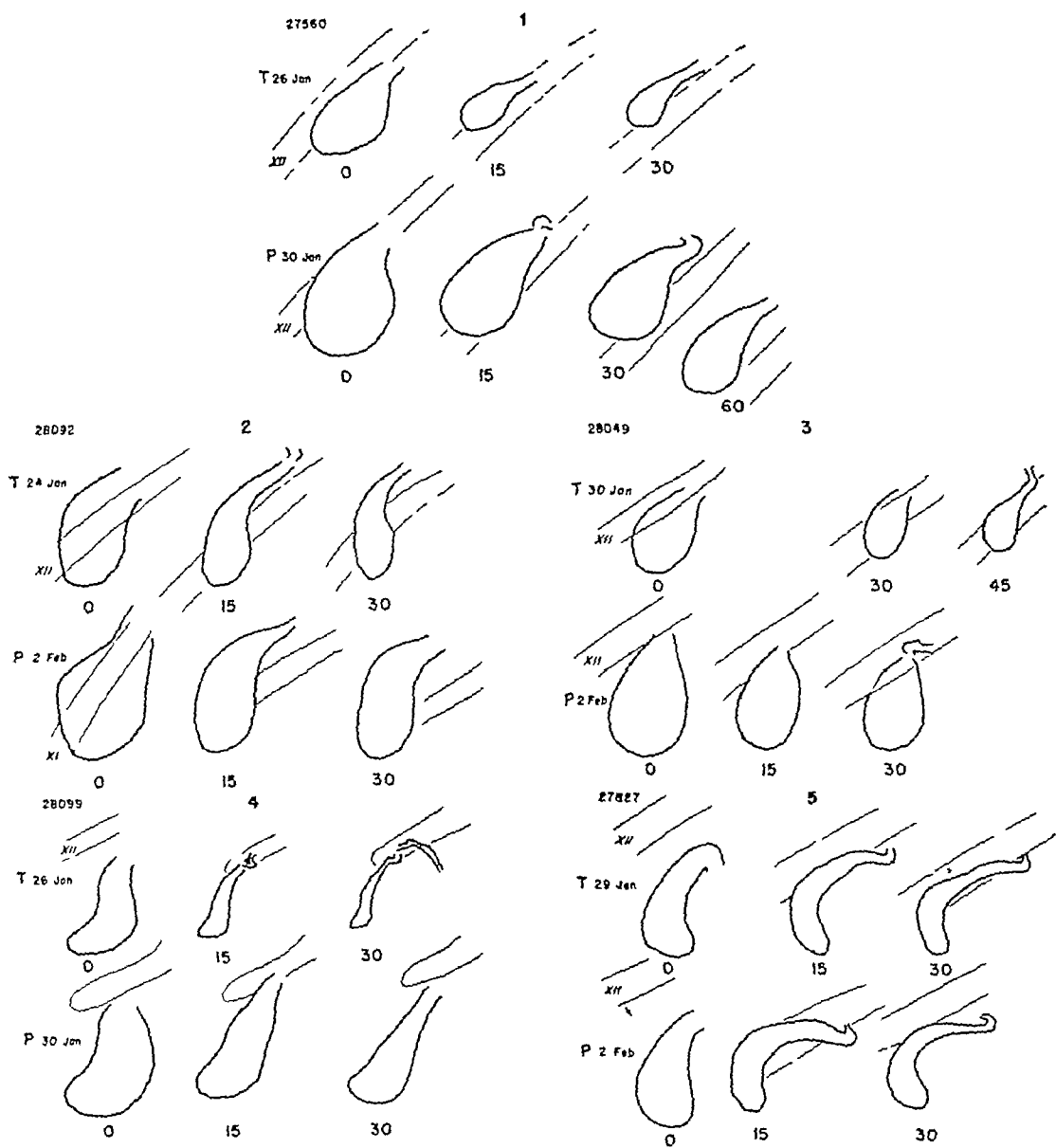


Fig 1 Gallbladders of five patients first examined after ingestion of 10 gm of tetraiodophthalein, and, again, from two to six days later, after the ingestion of 9 gm of Priodax. The Priodax-filled gallbladders are larger and emptying is slower.

All of the patients were examined under identical conditions of technic, so that the size of the gallbladder shadows was comparable. The outlines of the gallbladders were traced on onion-skin paper, the lines were inked in, and all of the tracings of the same series were mounted on one sheet of paper and photographed. The other series was prepared in the same way and photographed with the same factors.

The cases which were given the tetraiodophthalein first are shown in Figure 1. From three to six days later the examination was repeated with Priodax. The Priodax-filled gallbladders before the administration of the fat meal are consistently larger. Emptying was definitely slower with Priodax.

In Figure 2 are shown the gallbladders of the patients who were first given Priodax.



# Emptying of the Normal Gallbladder with Priodax<sup>1</sup>

LT COL BENJAMIN COPLEMAN, M C, A U S

FOLLOWING visualization of the gallbladder, we have routinely examined the patient at fifteen and thirty minutes after the ingestion of a fat meal<sup>2</sup> in order to study the contraction phase and, if possible, to demonstrate the cystic and the common ducts. This method is considered by Sussman (11) of greater importance than the mere determination of the gallbladder emptying time, since "a demonstration of a normal cystic and common duct provides a valuable confirmation of a normal function of the gallbladder and the sphincter of Oddi." Definite visualization of the hepatic ducts has also been accomplished by this method and has been interpreted as an indication of biliary dyskinesia (1, 3). The small size of the gallbladder, after partial emptying has occurred, often helps to bring into prominence small stones whose shadows might otherwise be obscured.

With the use of tetraiodophthalein, contractions of the gallbladder after the fat meal occurred promptly and vigorously, so that in over half of the normal cases the cystic and common ducts could be visualized.

During the past two years several articles have appeared on the use of a new substance, Priodax, for visualization of the gallbladder, but few of these mention a study of the emptying gallbladder. Einsel and Einsel (5) stated that most of the gallbladders examined with Priodax emptied 60 per cent in two hours. They noticed that the emptying process was more gradual than with tetraiodophthalein. Marshall (9) found "insufficient contraction, i e., poor function" in 8 of 50 cases examined two hours after the ingestion of a fat-protein meal. Bryan and Pedersen (2), who examined their patients thirty minutes

after a synthetic fat meal, found 73 per cent of a series of 845 to have normal gallbladders of average size, shape, and concentration, emptying over 50 per cent of their contents after the fatty meal. Hefke (6), who examined his patients forty-five minutes after the ingestion of 4 ounces of cream, also believes that the change in size of the gallbladder is of great aid in the diagnosis of stones. He will, on occasion, give a patient a second fat meal, not to achieve a certain degree of emptying, but to help further the differentiation between stones and gas shadows. None of the others who have written about Priodax has remarked on the changes in emptying (4, 7, 8, 10, 12, 13).

With the introduction of Priodax at this hospital, it was found almost immediately that visualization of the ducts had become uncommon, and emptying appeared to be prolonged. The impression was gained that, with comparable amounts of the opaque materials, the gallbladder became larger with Priodax than with tetraiodophthalein, that the emptying time was increased considerably and in many instances emptying was incomplete.

In order to test this impression, 5 patients were examined with Priodax and a few days later were re-examined with tetraiodophthalein. Another series of 5 patients was examined with tetraiodophthalein and a few days later with Priodax. Since we had previously been obtaining the most consistent cholecystographic results with 10 gm of tetraiodophthalein given in two doses, we used the nearest multiple of Priodax packages, each of which contains 3 gm, to obtain a dose of 9 gm for comparison. The patients were not selected except that their first cholecystographic examination was normal.

<sup>1</sup> From the Roentgenologic Service of Lovell General Hospital, Fort Devens, Mass. Accepted for publication in August 1945.

<sup>2</sup> Two eggs in 8 oz of a mixture of milk and thin cream, half and half with sugar added to taste.

and 2) the Priodax-filled gallbladders were comparable in size whether or not tetraiodophthalein had been given first. The findings in Case 11 are of interest, since it lends some support to the impression that Priodax suppresses gallbladder contraction and tonus.

It should be remarked that good contraction need not result in good visualization of the ducts (Case 9, Fig 2), but a failure of adequate emptying will surely decrease the incidence of such demonstrations.

### DISCUSSIONS

Too little attention is generally paid to gallbladder emptying. The importance of the contraction phase does not lie in the determination of the emptying time, but in the aid which it may give in the study of a group of patients whose gallbladders are well visualized but in whom there may be definite abnormality in the emptying mechanism, with the production of symptoms. A study of the contraction phase may also give valuable aid in the diagnosis of small stones.

The use of Priodax has adversely influenced the study of this phase because of the relaxation of gallbladder tonus. The action appears similar to that of a sympathicomimetic drug in that, compared with tetraiodophthalein, it relaxes the gallbladder. We have attempted to overcome this by administering a mixture of Priodax and tetraiodophthalein but, since no advantage was found, we have returned to the use of tetraiodophthalein.

### CONCLUSIONS

1. When the gallbladder is visualized with tetraiodophthalein, a fat meal usually produces prompt and vigorous emptying in the normal case. In more than half of the cases without stones, the cystic and common ducts may be visualized. In a small number of cases the demonstration of the hepatic duct or even its radicles may aid in the diagnosis of biliary dyskinesia. The decrease in size of the gallbladder also helps

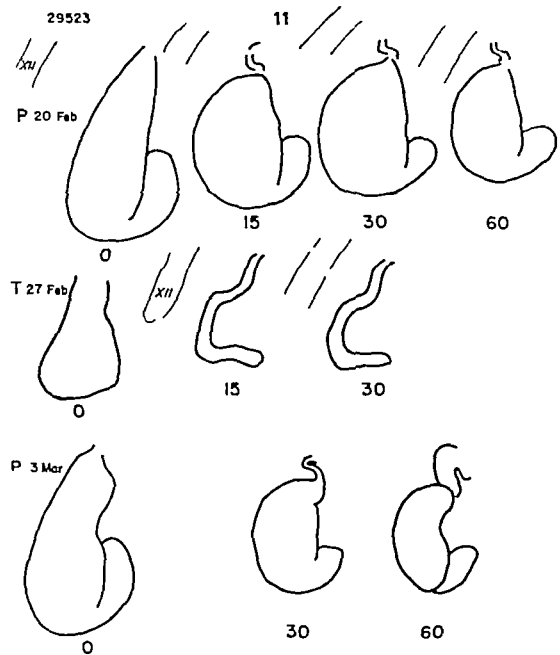


Fig 3 In this case the marked difference in response to Priodax and tetraiodophthalein prompted a re-examination with Priodax. The difference in size of the gallbladder with the tetraiodophthalein and the second series with Priodax is again striking. The size of the gallbladder in the second Priodax series is smaller than in the first, as though tetraiodophthalein had increased the gallbladder tonus in the interim.

in the differential diagnosis between gas shadows and small non-opaque stones.

2. Priodax, a new drug, while producing a dense gallbladder shadow, appears to interfere with gallbladder emptying and the visualization of the bile ducts. In comparison with tetraiodophthalein, Priodax acts like a sympathicomimetic drug.

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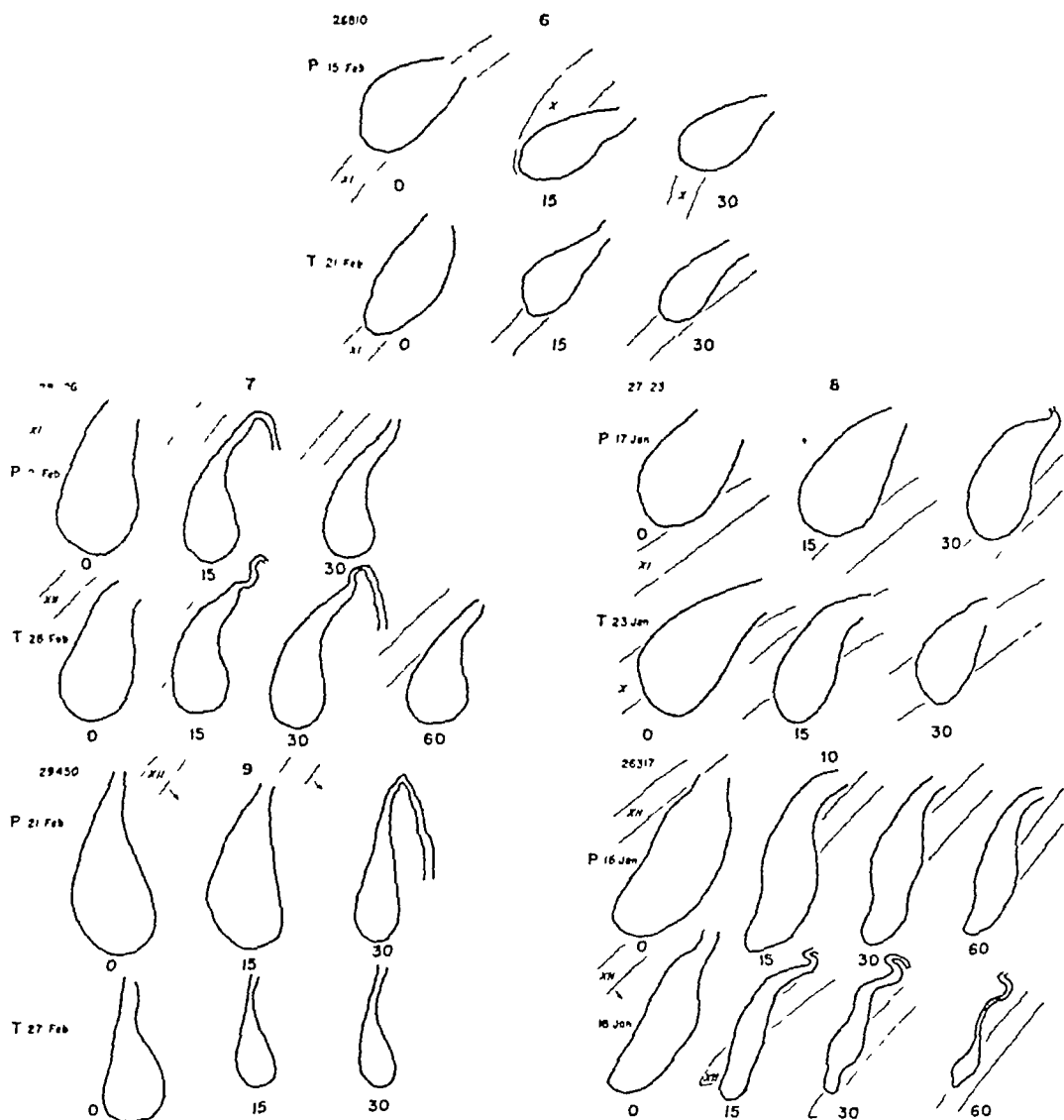


Fig. 2. Gallbladders of five patients first examined after ingestion of 9 gm. of Priodax, and, again, from two to six days later after ingestion of 10 gm. of tetraiodophthalein. Except for Case 7, the Priodax-filled gallbladders are larger and emptying is slower.

dax, and, from two to six days later, were re-examined after the ingestion of tetraiodophthalein. In Case 7 the emptying is generally equal for both drugs, but here again before the administration of the fat meal the Priodax-filled viscus is the larger. In Case 8 the gallbladder remains about the same size with each drug, although emptying is clearly more rapid with tetraiodophthalein.

Case 11 (Fig. 3) was first examined with Priodax and then with tetraiodophthalein.

The difference in response was so great that the examination was again performed with Priodax. The difference in size, including the filled resting stage before the fat meal, following tetraiodophthalein and the second series of Priodax was still marked.

It will be observed that the gallbladder in the second Priodax series was smaller than in the first, as though the tetraiodophthalein had increased the tonus of the organ. In the two series of patients (Figs. 1

# Pantopaque Myelography. Diagnostic Errors and Review of Cases<sup>1</sup>

LT COL. GEORGE L. MALTBY, M C, A U S, and LT COL ROBERT C PENDERGRASS, M C, A U S

NUMEROUS articles dealing with the use of Pantopaque in myelography have appeared in the medical literature in the past three years. While the more typical myelographic pictures due to rupture of the nucleus pulposus are easily recognizable, one occasionally encounters bizarre patterns whose interpretation is difficult. We wish to present some of these unusual patterns, to discuss common sources of error in diagnosis, and to review 215 Pantopaque myelograms. Of the 215 cases examined, 69 came to operation, and the myelographic findings will be compared with the preoperative diagnosis.

## TECHNIC

*Site of Injection* In myelography for detection of a protruded disk in the lumbar region, the needle should not be introduced at the level of the suspected protrusion, since removal of the oil may be more difficult and defects due to the needle may resemble those due to a protruded disk. If we encounter a defect at the site of introduction of the needle, it is our practice to remove it, continue the fluoroscopic and radiographic examination, and then re-insert the needle for withdrawal of the oil. (See Figs 9 and 10.)

*Fluoroscopic Study* Careful fluoroscopic observation is just as essential in Pantopaque myelography as in examination of the gastro-intestinal tract. Slowing of the oil column, its passage over an apparent partial obstruction or hump, and study of the side on which the narrowed column of oil ascends or descends are all valuable in forming final conclusions (Fig 5, B). All studies are carried out jointly by members of the neurosurgical and roentgenologic staffs. Spot films are made as indi-

cated, it is our usual practice to make two exposures of each level where the oil is observed, to check the constancy of defects.

*Equipment* The ideal table for fluoroscopic use is one which permits at least a 40° tilt in the reverse Trendelenburg position and full upright tilt. A limited range of excursion may be remedied by removing the curved head from the bottom of the table, substituting protective side panels, and installing a shock-proof fluoroscopic tube with cables. This will usually permit from 20 to 30° additional tilt toward the head. The gears on the average table are not constructed to permit this. Additional spacings may be cut in the ones already supplied.

*Spot-Film Device* While any spot-film device permitting rapid exposures may be used, we prefer to use one which provides two exposures on one 8 × 10-in film. Our device embodies a quick change switch from fluoroscopic to radiographic current and was locally constructed. Any such device must be provided with a protective brace which will prevent the screen and spot-film device from falling on the spinal puncture needle. Figure 13 shows such a device with a protective support. This support is readily adjustable for patients of varying thickness.

*Amount of Oil Used* The amount of Pantopaque customarily employed is 3 c c. Recently, we have used 5 and 6 c c in several instances. We believe that the additional amount is of advantage (1) for better filling of what is apparently a narrowed canal, (2) for better filling of the caudal sac, and (3) for the simultaneous visualization of several interspaces (Fig 12).

<sup>1</sup> From the Neurosurgical and Roentgenological Services, Ashford General Hospital, White Sulphur Springs, W. Va. Accepted for publication in August 1945. Read by title at the Thirty first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

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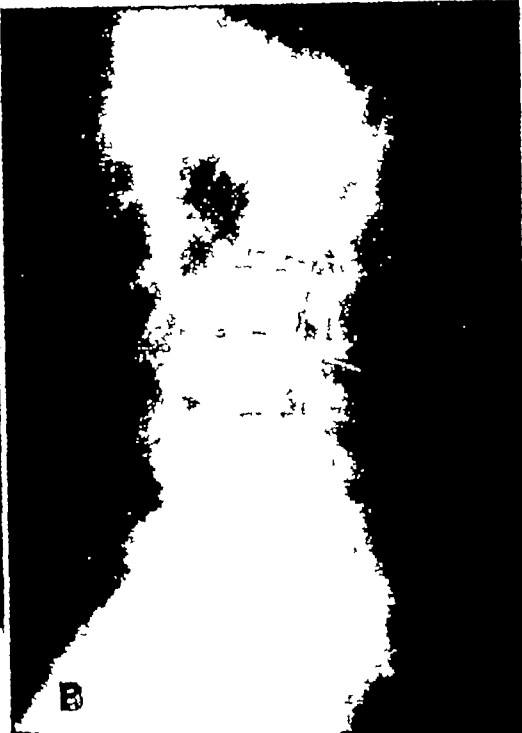


Fig 2 Oil injection following easy aspiration of spinal fluid. A Oil apparently in arachnoid space at L3-4 but extra arachnoid oil in two parallel columns with escape laterally at D11-12 and D12-L1. B Lateral view, showing extra arachnoid distribution of oil. Oil beneath needle point is also extra arachnoid. C Film nine days later showing distribution of oil along nerve roots with some absorption. D Repeat myelogram showing defect at L5-S1 left. Interpreted as disk defect, but found to be due to dilated veins.

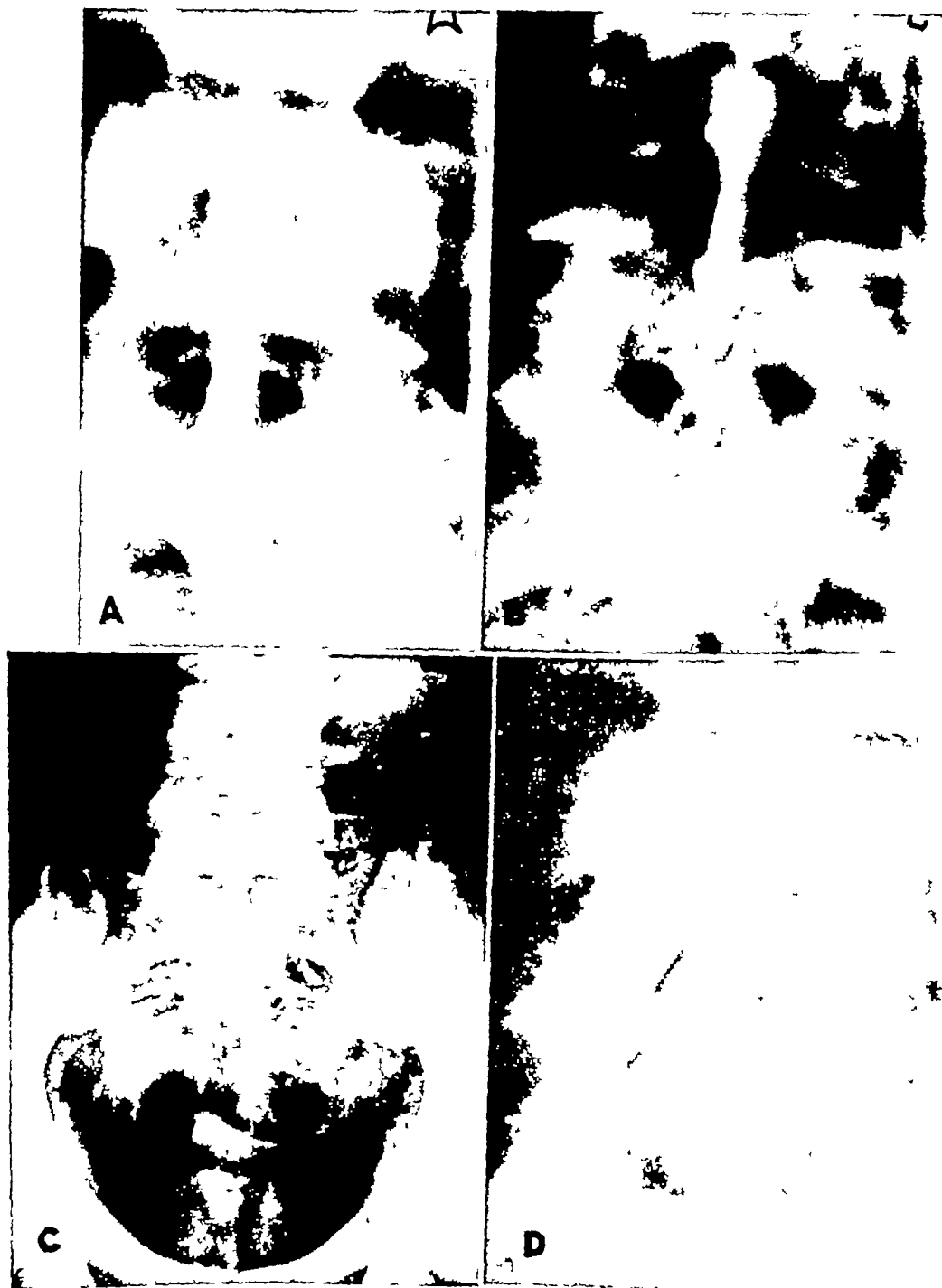


Fig 1 Extra-arachnoid escape of oil A Oil injected in arachnoid space with beginning escape along nerve roots B Wide distribution of oil along nerve sheaths, with patient in vertical position C Film two weeks later, showing oil along course of sacral and sciatic nerves D Repeat myelogram showing disk defect at L4-5 left Confirmed

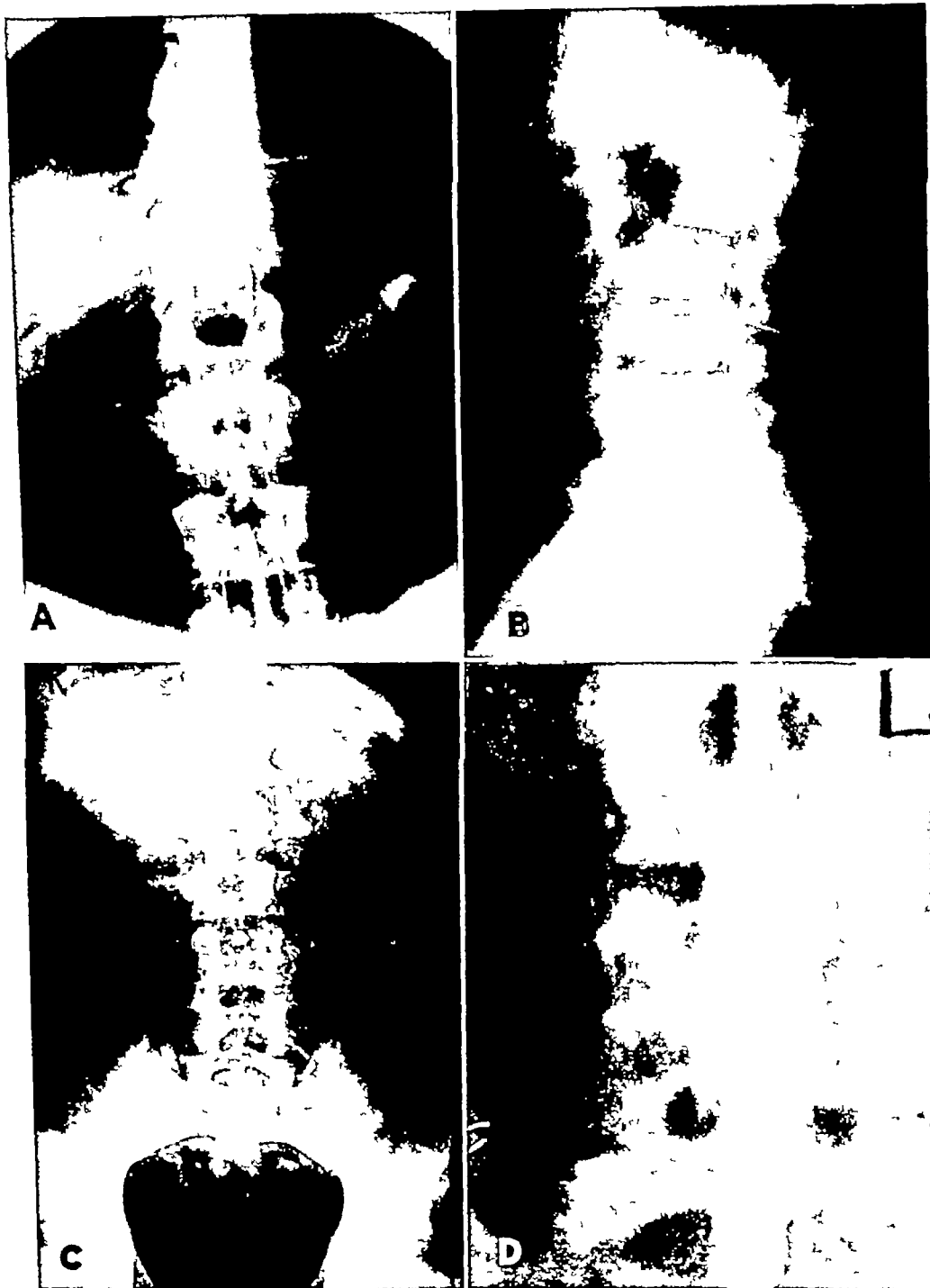


Fig 2 Oil injection following easy aspiration of spinal fluid A Oil apparently in arachnoid space at L3-4, but extra-arachnoid oil in two parallel columns with escape laterally at D11-12 and D12-L1 B Lateral view, showing extra-arachnoid distribution of oil Oil beneath needle point is also extra-arachnoid C Film nine days later, showing distribution of oil along nerve roots with some absorption D Repeat myelogram, showing defect at L5-S1 left. Interpreted as disk defect, but found to be due to dilated veins





Fig 3 A Oil in arachnoid space and along 4th and 5th lumbar roots, left B Film one week later Oil in arachnoid space has been aspirated but escaped oil remains along nerve roots

#### INTERPRETATION

At this hospital myelographic reports are given by the roentgenologic service on the basis of the findings on fluoroscopic and film examination alone. These reports are then correlated with the history and clinical findings, with special reference to neurological manifestations, at a joint conference between members of the roentgenologic and neurosurgical services. Review of the history and physical findings prior to the myelography may bias the opinion of the roentgenologist. In the summary of the cases to be presented later in this article, discrepancies will be noted between the diagnoses of the roentgenologic staff, the clinical opinion of the neurosurgeon, and the operative findings. In many instances the roentgenologic service has made a report in which certain defects in the oil column or filling of the root sleeves were noted. The statement is often made "These findings are suspicious of ruptured disk, but correlation with the clinical

findings will be necessary for a final diagnosis." Such a report is rendered not in a spirit of evasion but with the feeling that only by the correlation of all available evidence can a definite diagnosis be reached in many instances. The roentgenologic reports are made by various members of the staff, with varying experience in Pantopaque myelography. It is therefore felt that the findings described in this report may be somewhat typical of those in the average Army hospital, and may approach results achieved by different examiners in civilian practice.

#### SOURCES OF ERROR

*Extra-Arachnoid Injection of Oil* Injection of oil outside the arachnoid space has occurred in the hands of members of the neurosurgical staff with varying amounts of experience. When one considers the small distance between the subarachnoid space and the subdural space, it is not surprising that extra-arachnoid injection of oil may very easily occur. In many

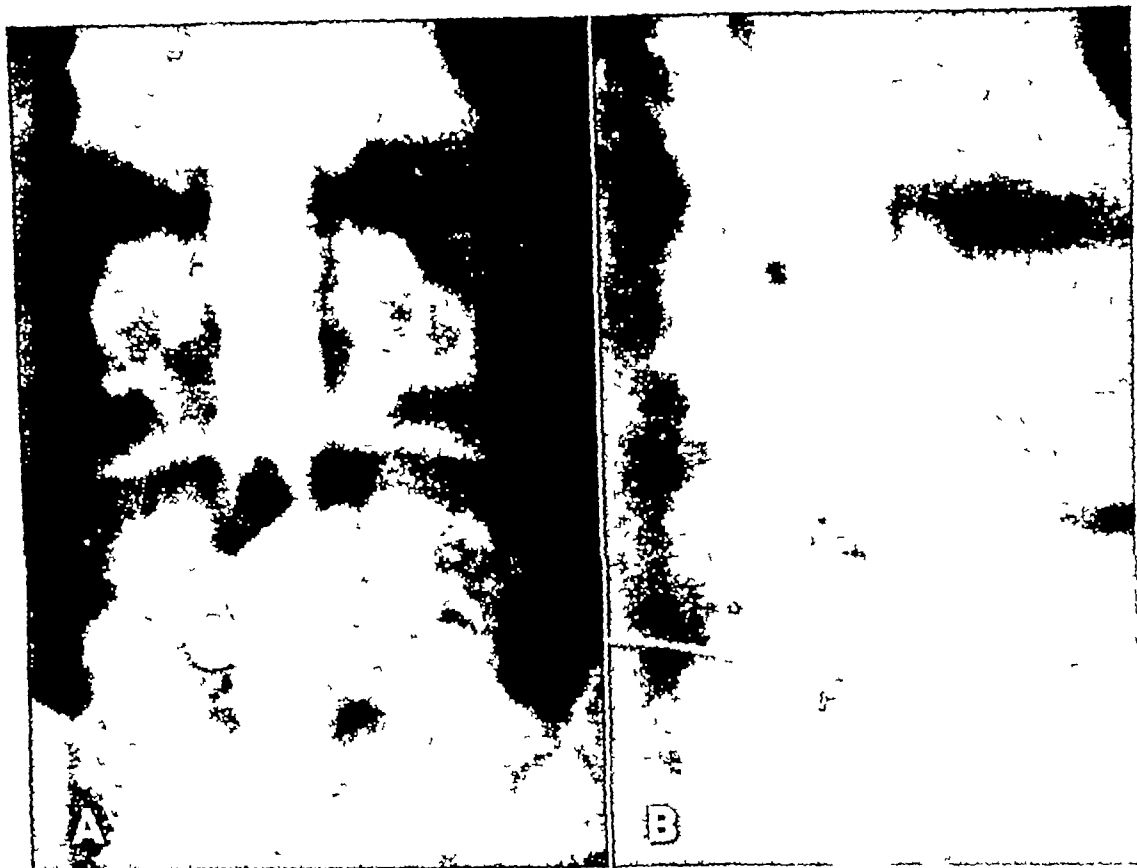


Fig 4 A Large defect on right at L4-5 with linear extensions into oil column overlying L3-4 B Oblique view, showing narrowing of oil column and linear streaking Linear defects found to be due to dilated veins, narrowing of column due to ruptured disk

instances the oil has been seen to escape into the subdural and extradural spaces even though spinal fluid was withdrawn without difficulty and no bleeding was encountered. The pattern produced by injection of oil outside the arachnoid space varies widely. In some instances it is represented by two parallel columns of oil with an unfilled center, somewhat similar to the pattern found in intramedullary tumors (Fig 2). In other instances the oil has been seen to escape through the foramina and apparently along the course of the lumbar and sacral nerves immediately after injection (Fig 3). This rapid escape of oil along the nerve roots seems to indicate passage through pre-existing channels rather than slow migration by way of the lymphatics.

One must recognize the patterns pro-

duced by subdural and epidural injection of oil in order that a false diagnosis of tumor, arachnoiditis, etc., will not be made. Oil injected in the 4th lumbar interspace often rapidly reaches the lower thoracic region, as illustrated in Figure 1, A.

It would appear that the extent of the arachnoid spaces and the dural sheaths outside the spinal canal is quite variable, if one is to judge by the manner in which oil is occasionally found distributed. Further study is indicated to determine the extent of the arachnoid and dura outside the vertebral canal. We have attempted to study this space by injection of oil in the subdural space at autopsy, but the findings to date are somewhat inconclusive, and it is planned to conduct further investigation along this line.

*Centrally Protruded Disk* Central pro-

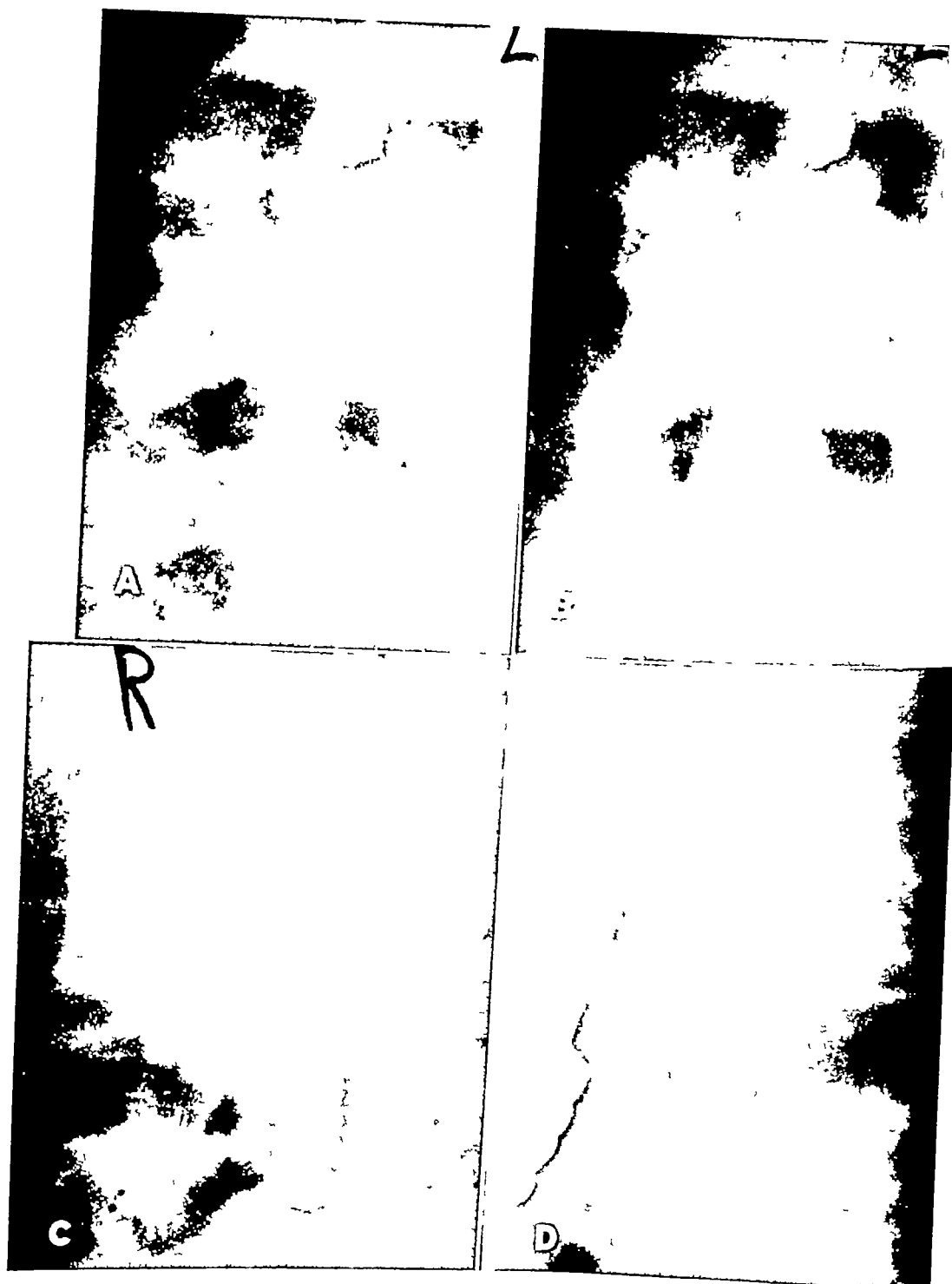


Fig 5 A Apparent complete division of oil column Clinical symptoms of paraplegia suggesting cauda equina tumor Large ruptured disk found at operation B Same case showing oil trickling through on right and joining two oil masses  
 C Block at L3-4 with feathered lower border of oil column Long history suggesting cauda equina tumor  
 D Oblique view of same case. Operation disclosed large ruptured disk and localized arachnoiditis

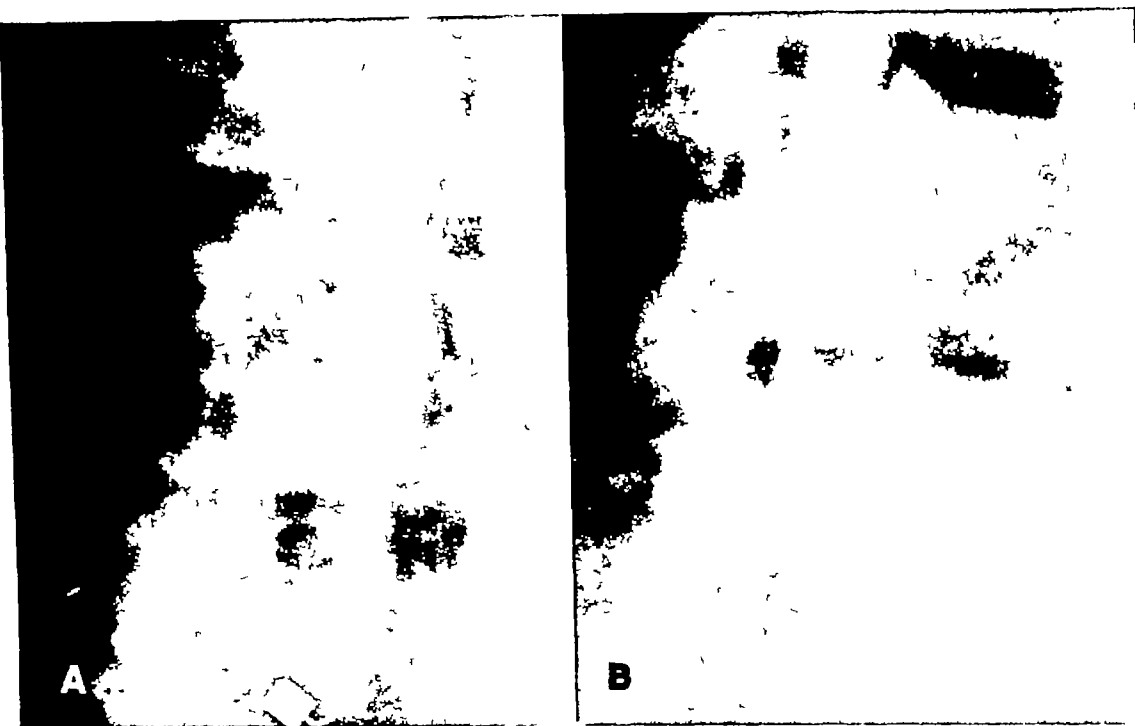


Fig 6 A Narrow canal with lateral defects at L3-4 and L4-5, with obliteration of root sleeves B Oblique view, showing defects at L3-4 and L4-5 Operation revealed protruded disks at both interspaces, with root compression

trusion of the disk may fail to produce any lateral deformities of the oil column, but the column may appear to be thinned overlying the disk. This fact has been ably discussed by Copleman (3) and more recently by Soule, Gross, and Irving (8). Our experience is in accord with theirs.

**Arachnoid Block** French and Payne (6) reported eight cases with cauda equina injury and complete blockage in association with ruptured intervertebral disks. We have observed two such cases in our series. Distinction from tumor may not be easy. In one case, in addition to a protruded disk there was a localized arachnoiditis (Fig 5, C and D).

**Varices** The myelographic pattern of varices of the cord has been described by several writers. We have observed two cases of very definite lateral defects of the central oil column produced by varices. Further study of the films has shown linear extensions of the deformity into the central oil column, which are not usually noted in the presence of a protruded disk. When-

ever this pattern is encountered, one should be suspicious of the presence of varices, although the coexistence of a ruptured disk or tumor cannot be ruled out (Fig 4).

**Adhesions** We have had occasion to do myelography on patients from whom a ruptured disk had previously been removed, who had symptoms suggestive of recurrence. The myelograms showed irregular deformity of the oil column. At operation, extensive scar tissue was found, producing pressure on the nerve roots, but no recurrent disk rupture. These cases present one of the most difficult diagnostic problems.

**Epidural Abscess** Figure 11 shows a rather unusual myelographic pattern obtained in a patient who had previously had a disk removed elsewhere. It was felt that a portion of the oil might lie epidurally, or that there might be extensive arachnoiditis or scarring following surgery. Operation disclosed an epidural abscess.

**Narrow Oil Column** As has been men-



Fig 7 Narrow canal with shallow lateral defect at L5-S1 right. Large ruptured disk found at operation

tioned by Camp (2), Soule *et al* (8), Arbuckle, Sheldon, and Pudenz (1), if the oil column is less than 16 mm in width, the protruded disk may not produce any defect demonstrable in the myelogram. We again wish to call attention to the advisability of using a large amount of oil to fill out what is apparently a narrow arachnoid space where this condition is encountered.

*Non-Filling or Incomplete Filling of the Root Sleeves* The filling of root sleeves by Pantopaque is so variable that we do not feel that a definite diagnosis can be based upon non-filling alone. However, good filling on one side, associated with poor filling on the other, or absence of filling, constitutes evidence suspicious of a ruptured disk. In cases where one root sleeve at a certain level filled well and the opposite one did not fill well, we have found that, if the patient was placed in a lateral position with the unfilled side down, it could often be satisfactorily filled. Fail



Fig 8 A Notching of oil column on right at L3-4. Obvious needle defect. B Same case with deflection of oil column to left by ruptured disk at L5-S1 right. Confirmed at operation.

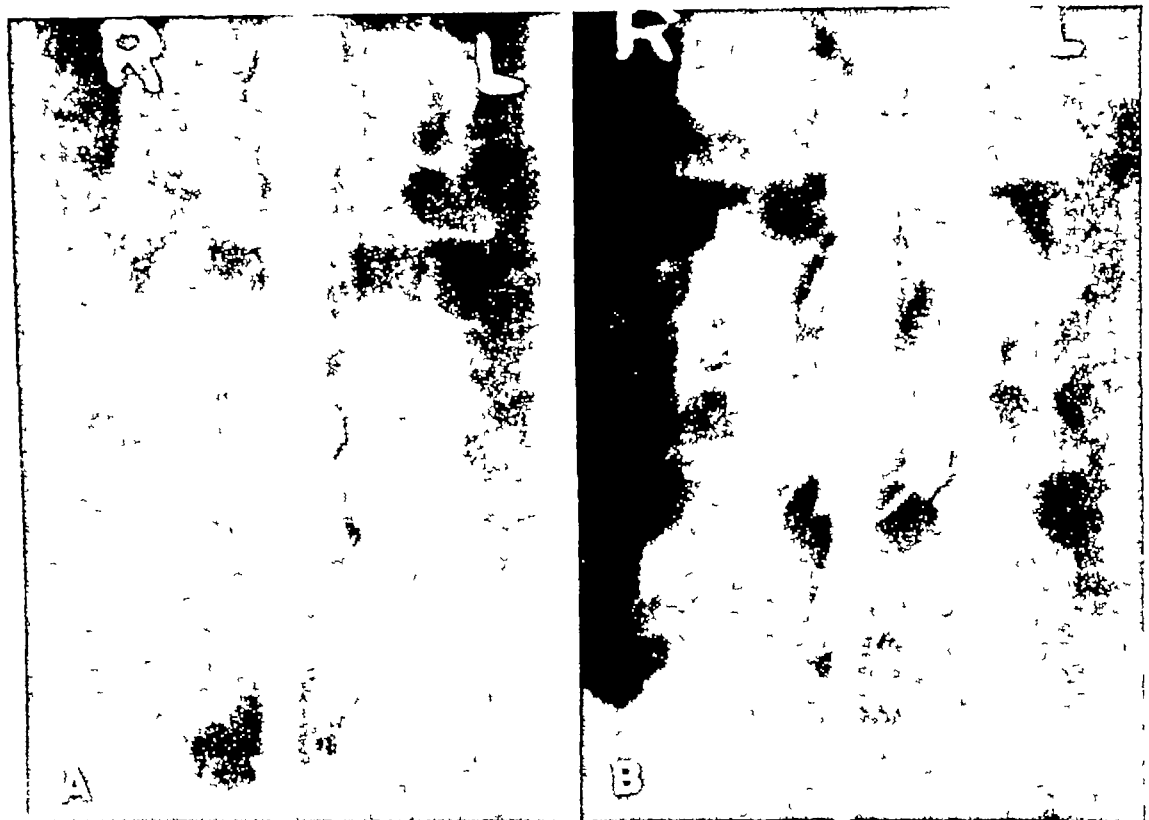


Fig 9 A Needle defect at L3-4 left, very narrow column at L5 S1 B Needle re inserted at L4-5, defect at L3-4 now absent Shallow indentation of narrow column at L5-S1 left, due to large ruptured disk Confirmed at operation

ure to use this maneuver may result in false impressions Epstein (5) called attention to the use of the Valsalva maneuver in the attempt to force oil into the root sleeves We have not found this uniformly successful While it was used routinely in several cases, it has now been abandoned As mentioned by Scott and Furlow (7), however, the Valsalva maneuver (expiration with glottis closed) does provide a usually painless method of expelling the oil through the lumbar puncture needle after the examination is completed This method is somewhat slower, as a rule, than aspiration, but it is more comfortable for the patient and is often just as effective We usually attempt aspiration and, if that is not successful, resort to the Valsalva maneuver or have the patient cough several times

In reference to technic and interpretation, we wish to emphasize that films of

good diagnostic quality are just as important in myelography as in any other roentgenologic study Only by having films of good detail and sufficient contrast to show various oil densities can one obtain the maximum amount of information from the radiographs A procedure such as myelography, which involves pre-operative preparation, spinal puncture, probable headache after spinal puncture, and effort and time on the part of the neurosurgeon and radiologist, should not be jeopardized by technically poor films

REVIEW OF CASES

There were 215 instances in which the history, signs, and symptoms of a ruptured nucleus pulposus were such that the neurosurgical staff felt that myelography was indicated In 107 patients the x-ray findings confirmed the clinical impression and showed changes compatible with a rup-

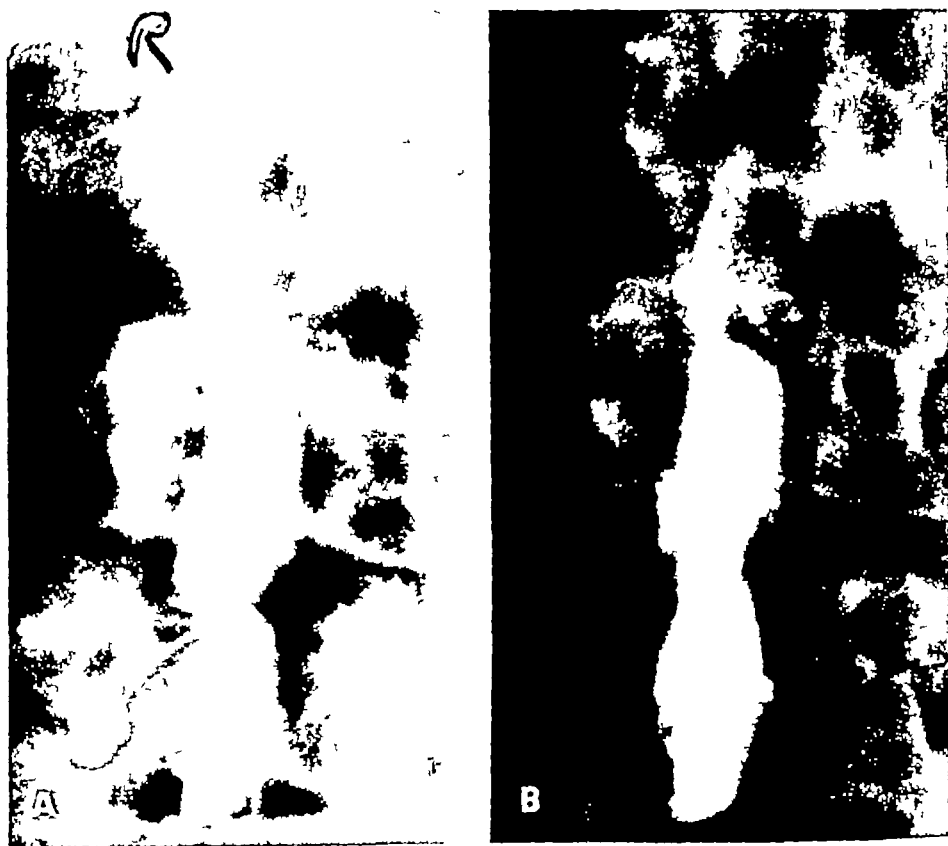


Fig 10 A Defect at needle point L4-5 left B Defect remains after removal of needle. Ruptured disk.

tured intervertebral disk. There were also 8 instances in which an abnormal myelogram could not be considered characteristic of a ruptured disk. This group will be discussed later.

Of the 107 patients with positive myelograms, 57 (53 per cent) were operated upon. Of these 57 patients, 51 (89.4 per cent) showed a disk lesion at operation. Six patients (10.6 per cent) had negative explorations. Nine patients with negative x-ray findings were operated upon, because of what seemed to be classical clinical findings of a ruptured disk. In 5 (56 per cent) of these 9 patients, the findings on exploration were negative, while 4 (44 per cent) were found to have a definite rupture of the nucleus pulposus.

It may be considered somewhat unusual that such a small proportion of this group were subjected to surgery. This fact may

be explained by the conservative of view taken both by the Army Department and this Neurosurgical Center as to the indications for surgery of this condition in military personnel. Many patients in spite of positive findings, both clinical and roentgen, showed minimal disability and could be turned either to limited duty in the military or to their civilian occupations without operative treatment.

The 8 abnormal myelograms mentioned above, which could not be considered characteristic of a ruptured disk, may be considered briefly. These were divided with respect to the x-ray diagnosis as follows:

Myelograms suspicious of ruptured disk but needing clinical confirmation  
Arachnoiditis

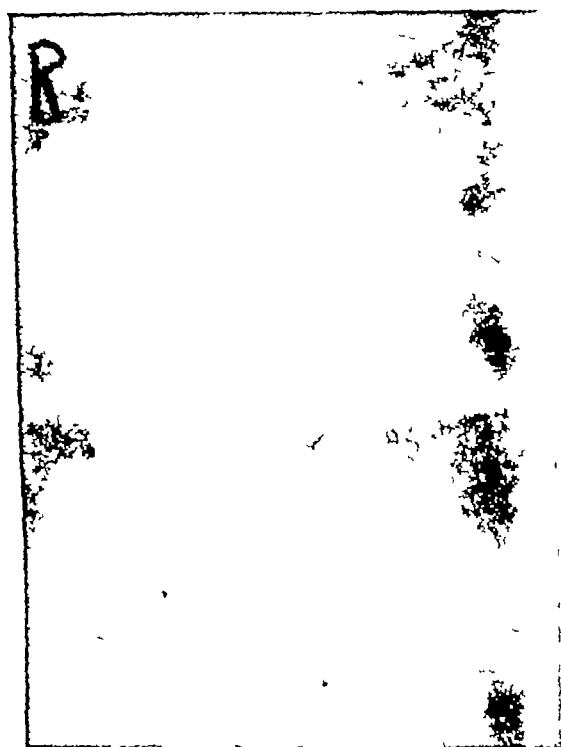


Fig 11 Myelogram following previous operation for disk. Bizarre central defect at L3-4, found at operation to be due to epidural abscess

Postoperative scar tissue	1
Unsatisfactory, because of extra-arachnoid oil	1
Multiple filling defects, cause unknown	1
Block	1

Of the 8 patients, 3 came to operation. In the case labeled "postoperative scar tissue" a recurrent disk was found. The one diagnosed simply as "block" showed a small epidural abscess, and the one considered as "roentgenologically suspicious of a disk but needing clinical confirmation" showed a ruptured disk.

#### SUMMARY AND CONCLUSIONS

1 A study has been made of 215 consecutive lumbar myelograms in order to determine the sources of diagnostic error. Some of the errors are described and illustrated.

2 The technique of myelography is briefly reviewed, with suggestions as to apparatus to be employed.

3 The diagnostic and operative statis-

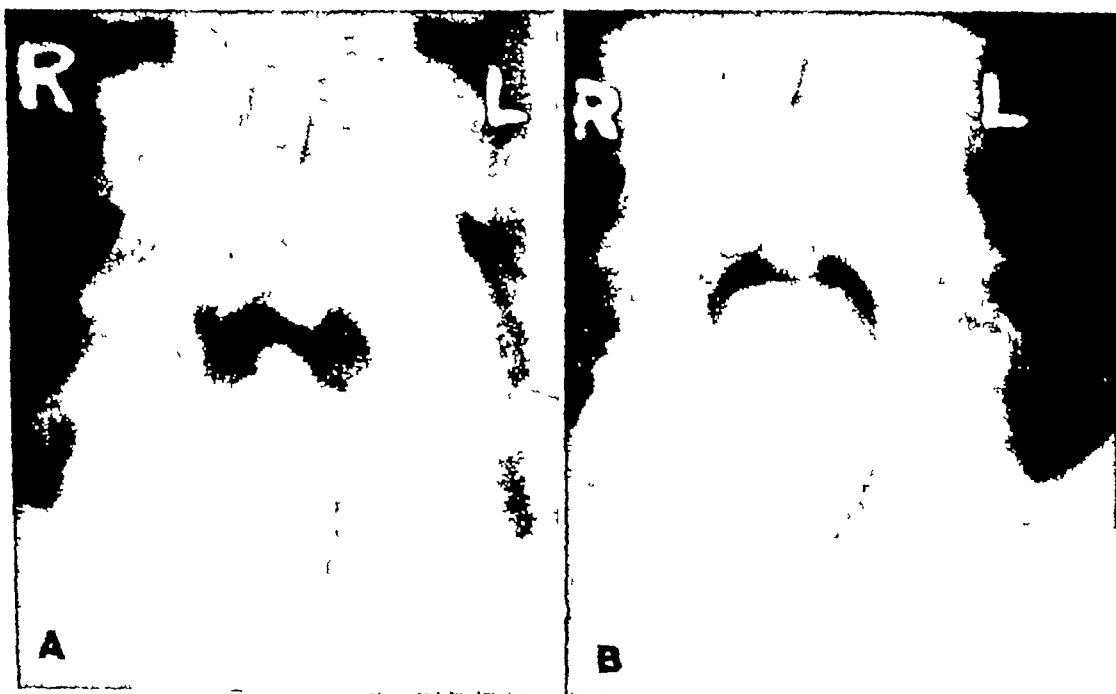


Fig 12 A Unfilled left root sleeve at L5 S1 with 3 cc of oil. B Same case with 6 cc left root sleeve filled but shorter than the right. Normal myelogram. No operation.



# Iodinated Organic Compounds as Contrast Media for Radiographic Diagnoses

## V Escape of Pantopaque from the Intracranial Subarachnoid Space of Dogs<sup>1</sup>

WILLIAM H. STRAIN, PH D, J. DOUGLAS FRENCH, M D, and GLENN E. JONES

Departments of Radiology and Surgery (Neurosurgery), School of Medicine and Dentistry and Strong Memorial Hospital, The University of Rochester, Rochester, N. Y.

AFTER MYELOGRAPHY with oil-type contrast media, some of the opaque substance may be left in the spinal canal at the end of the examination. When Pantopaque was developed for myelography, it was reported that such residues were absorbed in a relatively short time (6). Clinical experience, however, has shown that there is great variability in the rate of absorption in man (4, 11), and it seemed desirable to study both pathways and mechanisms by which the medium is eliminated. Through this work has led to the discovery that the cribriform plate is permeable to Pantopaque, and that this pathway may be an important avenue for the escape of the medium from the subarachnoid space in certain orders.

An experimental demonstration of the permeability of the cribriform plate to Pantopaque is easily carried out in dogs by introducing the medium into the cranial cavity of an anesthetized animal in a prone position with its head down. Oil-type media of lower viscosity than Pantopaque pass through the plate even more readily, while more viscous media, such as lipiodol, do not seem to penetrate; emulsions of oil-type media also do not permeate the plate. After passing through the cribriform plate, Pantopaque follows along the tissues of the nasal cavities to the lymphatics of the head and finally collects in the lymphatics of the head and neck. A series of roentgenograms showing the progressive absorption of the medium is reproduced in Figure 1 (A-F). From these films it is apparent that extension also occurs along the cranial nerves to some extent.

Demonstration of the passage of Pantopaque through the cribriform plate is conveniently carried out with dogs under continuous Nembutal anesthesia. In a typical experiment, an animal weighing 20 kg. was placed in a prone position with its head down and its body elevated at an angle of about 15° to the horizontal. A cisternal puncture was made, 8 c.c. of spinal fluid aspirated, and 5 c.c. of Pantopaque introduced into the subarachnoid space. Under continuous anesthesia the dog was maintained with its head down for a period of six hours. Lateral and ventrodorsal roentgenograms taken at intervals showed that the medium passed rapidly through the cribriform plate after about two hours, although the rate may be a function of the degree of inclination of the animal. Complete visualization of the tissues of the nasal cavities and of the lymphatics of the head was obtained after five or six hours. The dog survived the experiment well and did not show any deleterious effects over an observation period of several months.

Similar experiments with lipiodol and with a 50 per cent aqueous emulsion of Pantopaque gave negative results. Ethyl iodophenylvalerate (3) and iodobenzene, media much less viscous than Pantopaque, in many ways gave superior visualization but were so toxic that they could not be employed for survival experiments.

In an earlier publication (6) on the experimental study of the rate of elimination of Pantopaque from the subarachnoid space of dogs, it was estimated that about 3 c.c. of the medium was absorbed in a year. The mechanism by which this ab-

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<sup>1</sup> Accepted for publication in October 1945. This work was aided by a grant from the Research Laboratories of the Eastman Kodak Co., Rochester, N Y.

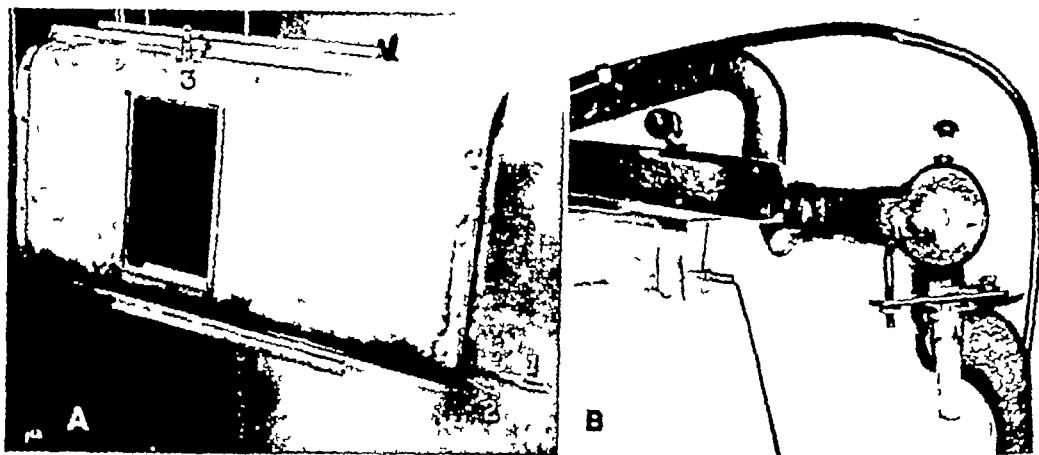


Fig 13. A Spot film device used in myelography and gastro intestinal examinations, showing one half of 8 X 10 inch cassette ready for exposure. 1 Bar with ring used to return cassette to fluoroscopic position and close fluoroscopic switch setting. 2 Trip lever used to throw half of cassette in radiographic position and close radiographic switch. 3 Lever to throw second half of cassette in radiographic position.

B Adjustable bracket to support fluoroscopic arm. Threaded bolt permits varying height of spot film device for patients of different thickness.

tics in this group have been briefly summarized.

4 The roentgenologic interpretations were made by several observers and are believed to represent a fair cross section of such interpretations in Army hospitals.

5 We wish to emphasize the necessity of close correlation of the clinical and roentgenologic findings.

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AFTER MYELOGRAPHY with oil-type contrast media, some of the opaque substance may be left in the spinal canal at the end of the examination. When Pantopaque was developed for myelography, it was reported that such residues were absorbed in a relatively short time (6). Clinical experience, however, has shown that there is great variability in the rate of absorption in man (4, 11), and it seemed desirable to study both pathways and mechanisms by which the medium is eliminated. In dogs this work has led to the discovery that the cribriform plate is permeable to Pantopaque, and that this pathway may be an important avenue for the escape of the medium from the subarachnoid space in lower orders.

Experimental demonstration of the permeability of the cribriform plate to Pantopaque is easily carried out in dogs by running the medium into the cranial cavities of an anesthetized animal in a prone position with its head down. Oil-type media of lower viscosity than Pantopaque pass through the plate even more readily, but more viscous media, such as lipiodol, do not seem to penetrate, emulsions of oil-type media also do not permeate the plate. After passing through the cribriform plate, Pantopaque follows along the tissues of the nasal cavities to the lymphatics of the head and finally collects in the lymph nodes of the head and neck. A series of roentgenograms showing the progressive extension of the medium is reproduced in Figure 1 (A-F). From these films it is apparent that extension also occurs along the cranial nerves to some extent.

Demonstration of the passage of Pantopaque through the cribriform plate is conveniently carried out with dogs under continuous Nembutal anesthesia. In a typical experiment, an animal weighing 20 kg. was placed in a prone position with its head down and its body elevated at an angle of about 15° to the horizontal. A cisternal puncture was made, 8 c.c. of spinal fluid aspirated, and 5 c.c. of Pantopaque introduced into the subarachnoid space. Under continuous anesthesia the dog was maintained with its head down for a period of six hours. Lateral and ventrodorsal roentgenograms taken at intervals showed that the medium passed rapidly through the cribriform plate after about two hours, although the rate may be a function of the degree of inclination of the animal. Complete visualization of the tissues of the nasal cavities and of the lymphatics of the head was obtained after five or six hours. The dog survived the experiment well and did not show any deleterious effects over an observation period of several months.

Similar experiments with lipiodol and with a 50 per cent aqueous emulsion of Pantopaque gave negative results. Ethyl iodophenylvalerate (3) and iodobenzene, media much less viscous than Pantopaque, in many ways gave superior visualization but were so toxic that they could not be employed for survival experiments.

In an earlier publication (6) on the experimental study of the rate of elimination of Pantopaque from the subarachnoid space of dogs, it was estimated that about 3 c.c. of the medium was absorbed in a year. The mechanism by which this ab-

<sup>1</sup> Accepted for publication in October 1945. This work was aided by a grant from the Research Laboratories of the Eastman Kodak Co., Rochester, N. Y.

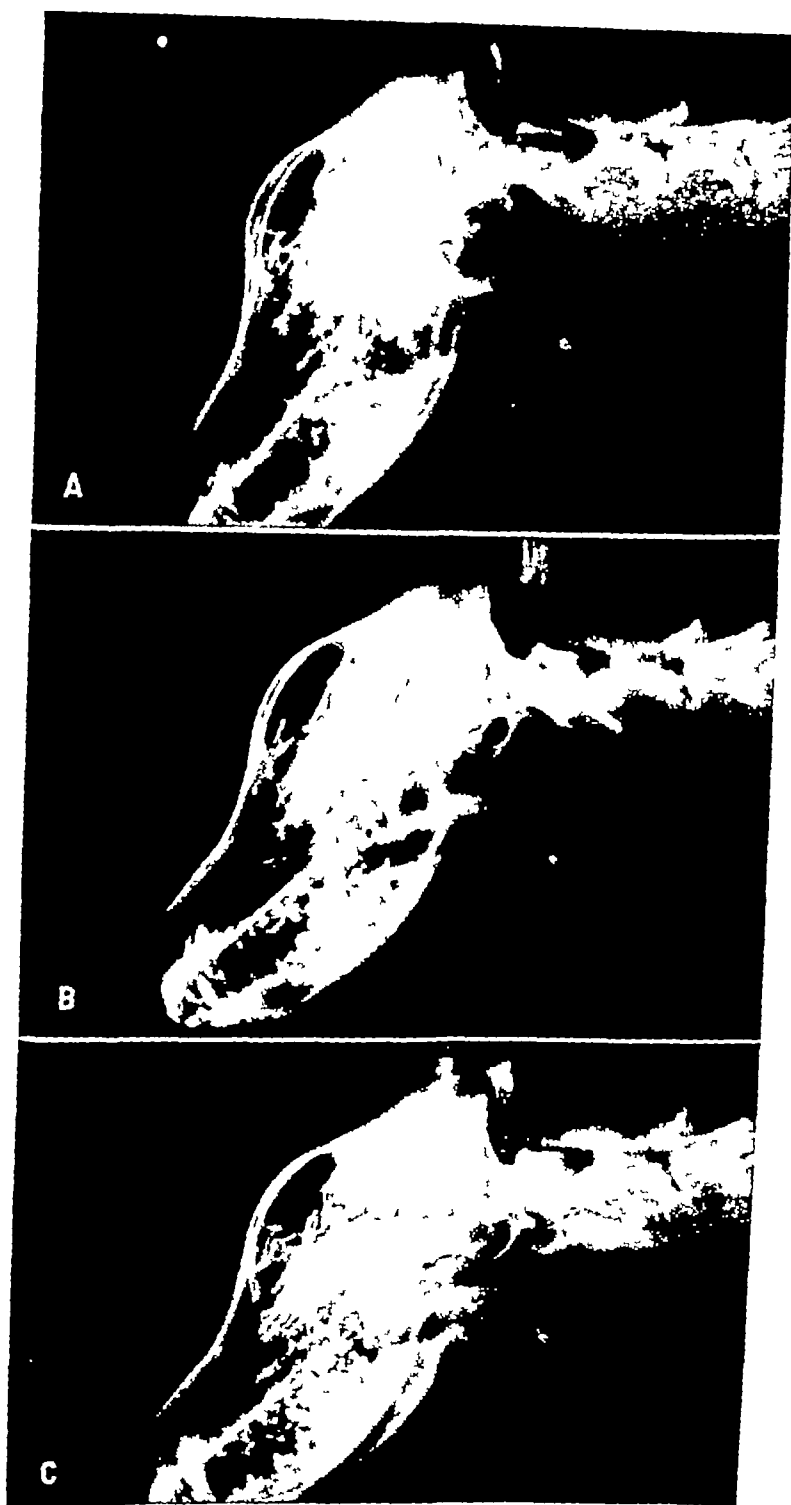


Fig 1 Passage of Pantopaque through the cribriform plate of a dog  
 A Position of the medium in the cranial cavities ten minutes after injection  
 B Contact of the opaque ester with the cribriform plate 90 minutes after injection  
 C Passage of Pantopaque through the cribriform plate and along the tissues of the nasal cavities 210 minutes after injection

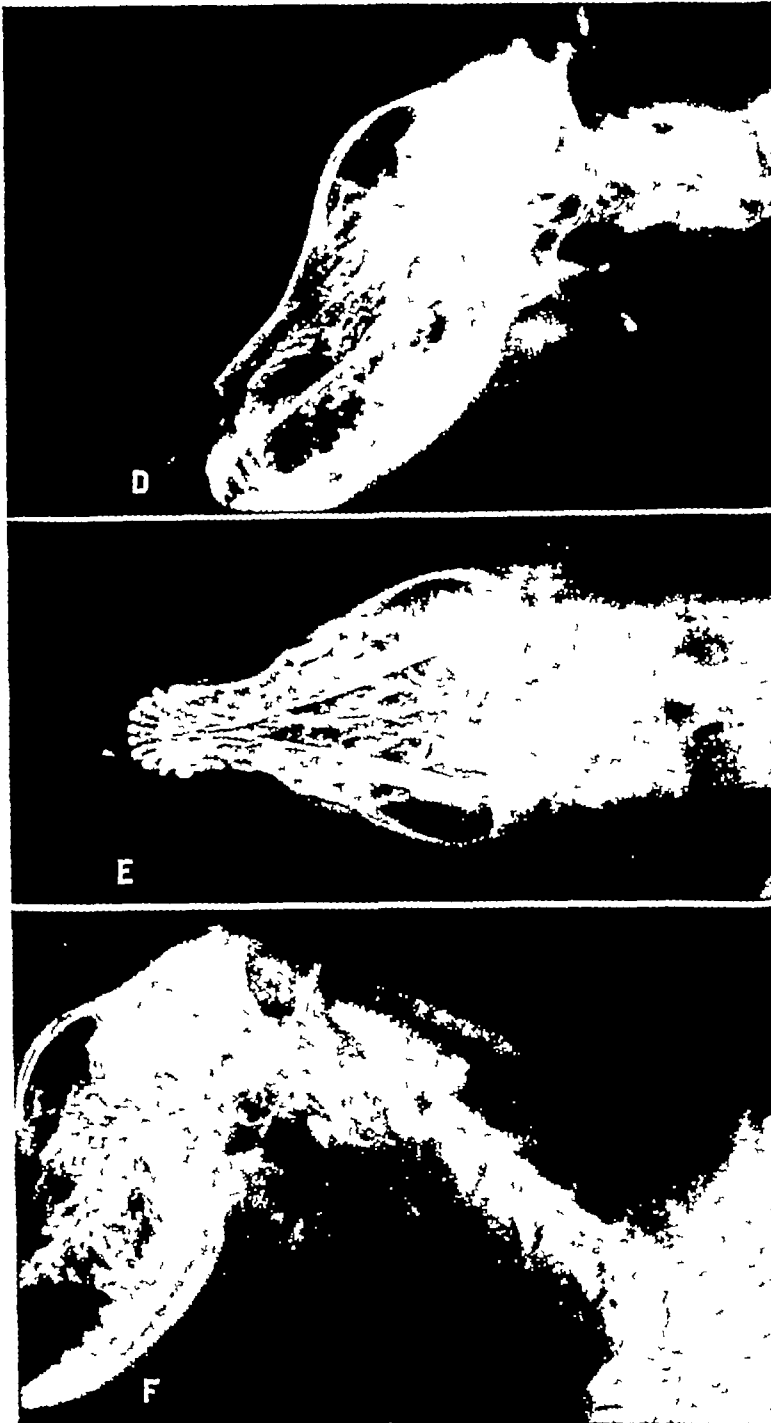


Fig 1 D Visualization of a number of lymphatics as well as the tissues of the nasal cavities 390 minutes after injection E Dorsoventral view showing visualization of the optic nerves 390 minutes after injection The medium may be present in the so-called perineural spaces F Roentgenogram taken two days after the injection, note the small amount of Pantopaque remaining in the cranial cavities and the accumulation of opaque medium in the lymph nodes of the head and neck

Roentgenograms A-E were made while the dog was under continuous anesthesia, the body in a prone position, and the head dependent Following recovery from anesthesia the animal was in excellent condition, and has shown no deleterious effects during an observation period of several months

sorption occurs is unknown. It has been observed that there is great variation among dogs in the rate of absorption of the medium. The explanation of this variability may be that in some animals a substantial portion of the medium enters the intracranial cavities and passes out through the cribriform plate.

Clinically, the rate of absorption of Pantopaque appears to be of the order of 0.5-1.0 cc per year (4, 11), with exceptional cases where the medium disappears from the subarachnoid space with some rapidity. It seems improbable that elimination through the cribriform plate can play an important role in man because of the postural differences between man and quadrupeds. Indeed, it does not follow from the animal experiments reported here that Pantopaque can pass through the cribriform plate in man. There is the possibility that the medium may be absorbed *via* the spaces about the peripheral nerves. To date there is no evidence supporting such an hypothesis, even though in a number of instances the opaque medium has followed along the nerve sheaths or nerves for a considerable distance.

The demonstration of the connection between the subarachnoid space and the lymphatics of the head *via* the cribriform plate and the tissues of the nasal cavities is not new, it has been carried out previously by several methods. Among such procedures, those in which electrolytes have been employed are well summarized by Weed (8, 9), and others, in which particulate matter such as India ink have been used, are reviewed and extended by Speransky (7), additional data have been collected by Rouvière (5). Roentgenographic methods using Thorotrast have been employed by Wustmann (10), and by Mortensen and Sullivan (2), the latter authors have also employed Brominol. Consideration of the collected information on the absorption of cerebrospinal fluid (1) shows that much of it is qualitative in nature, and that there is a dearth of information as to the relative importance of the several possible routes for the

escape of the spinal fluid. It would appear that the roentgenographic method might be developed into a satisfactory procedure for the study of the physiology of the cerebrospinal fluid.

#### SUMMARY

Pantopaque introduced into the cranial cavities of dogs readily passes through the cribriform plate into the tissues of the cranial cavities and the lymphatics of the head. This pathway may play an important part in the absorption of the medium in lower orders. By utilization of this effect, a roentgenographic method for the study of neuroanatomy and neurophysiology of the head may be possible.

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# Delayed Excretory Urography Value of the Twenty-Four-Hour Urogram<sup>1</sup>

MAJ NORMAN HEILBRUN, M C , A U S , and MAJ GEORGE CHITTENDEN, M C , A U S

WITH EXCRETORY urography one of the manifestations of acute or chronic ureteral obstruction is a delay in the appearance of the contrast substance in the collecting system on the affected side,

it is sometimes assumed that this is the site of the obstruction. In some cases, however, when no such shadow is present, it may be assumed that the obstruction is due to a non-opaque stone or to ac-



Figs 1 and 2 Case 1

Fig 1 Catheter in the left ureter at the point of obstruction  
Fig 2 Fifteen minute urogram showing a positive nephrogram on the left side. Note the calculus shadow in the region of the left kidney pelvis

whether it be from an intrinsic or an extrinsic cause. When the ureteral obstruction is recent, whether due directly or indirectly to the passage of a stone, the delay manifests itself first by an accentuation of the kidney shadow on the involved side, commonly known as a positive nephrogram. If a stone shadow is noted,

accompanying spasm. In either case, if necessary, the studies are carried beyond the nephrogram stage up to one to four hours. Usually by that time the collecting system and ureter will be well outlined to the point of block. If the point of obstruction has not then been established accurately, clinical judgment will determine whether to catheterize the ureter or to use more conservative measures.

<sup>1</sup> Accepted for publication in August 1945



sorption occurs is unknown. It has been observed that there is great variation among dogs in the rate of absorption of the medium. The explanation of this variability may be that in some animals a substantial portion of the medium enters the intracranial cavities and passes out through the cribriform plate.

Clinically, the rate of absorption of Pantopaque appears to be of the order of 0.5-1.0 c.c. per year (4, 11), with exceptional cases where the medium disappears from the subarachnoid space with some rapidity. It seems improbable that elimination through the cribriform plate can play an important role in man because of the postural differences between man and quadrupeds. Indeed, it does not follow from the animal experiments reported here that Pantopaque can pass through the cribriform plate in man. There is the possibility that the medium may be absorbed *via* the spaces about the peripheral nerves. To date there is no evidence supporting such an hypothesis, even though in a number of instances the opaque medium has followed along the nerve sheaths or nerves for a considerable distance.

The demonstration of the connection between the subarachnoid space and the lymphatics of the head *via* the cribriform plate and the tissues of the nasal cavities is not new; it has been carried out previously by several methods. Among such procedures, those in which electrolytes have been employed are well summarized by Weed (8, 9), and others, in which particulate matter such as India ink have been used, are reviewed and extended by Speransky (7), additional data have been collected by Rouvière (5). Roentgenographic methods using Thorotrast have been employed by Wustmann (10), and by Mortensen and Sullivan (2), the latter authors have also employed Brominol. Consideration of the collected information on the absorption of cerebrospinal fluid (1) shows that much of it is qualitative in nature, and that there is a dearth of information as to the relative importance of the several possible routes for the

escape of the spinal fluid. It would appear that the roentgenographic method might be developed into a satisfactory procedure for the study of the physiology of the cerebrospinal fluid.

#### SUMMARY

Pantopaque introduced into the cranial cavities of dogs readily passes through the cribriform plate into the tissues of the cranial cavities and the lymphatics of the head. This pathway may play an important part in the absorption of the medium in lower orders. By utilization of this effect, a roentgenographic method for the study of neuroanatomy and neurophysiology of the head may be possible.

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The physical examination revealed no gross abnormalities. The temperature was  $99^{\circ}$ . There was pain in the left loin and costovertebral angle on deep pressure and percussion. The urine now contained many red blood cells. Sedatives and fluids were prescribed.

Cystoscopy was done the morning of May 5, 1944. A catheter was placed in the left ureteral orifice and an obstruction was met just beyond (Fig 1). Attempts to pass a bougie, a Johnson basket, and a stone dislodger were all unsuccessful. Following this, the upper leaf of the left ureteral orifice was incised with cystoscopic scissors.

After the cystoscopy, excretory urograms were made. The preliminary plain abdominal film showed both kidneys outlined in normal position. There was a  $7 \times 5$ -mm shadow of calcific density in the region of the left ureteropelvic junction, and several phlebotomies were seen on both sides of the pelvis, but no stone was demonstrable at the site of the obstruction in the lower left ureter. Studies made at five and fifteen minutes showed a positive nephrogram on the left with no dye in the collecting system (Fig 2). The right side was normal. The studies were not carried beyond thirty minutes at this time.

At twenty-four hours an abdominal film showed the left pelvis, calices, and ureter well outlined to a point just above the ureterocystic junction, which was where the obstruction was found when the left ureter was catheterized the day before (Fig 3, A and B). The calculus previously noted in the region of the left ureteropelvic junction had not changed its position. Similar findings were noted at forty-eight hours, but the density of the collecting system was much less, indicating that partial drainage had occurred. It was felt that the block was due either to a non-opaque stone or to stone fragments too small to be visualized.

Another excretory urogram was made on May 8, 1944, three days after the first examination. A positive nephrogram was again obtained on the left side. The twenty-four-hour study, however, did not show any accumulation of the contrast substance in the collecting system, indicating that the block was not so great as at the time of the examination three days before.

Another attempt to catheterize the left ureter was made on May 11, but was unsuccessful. The left ureteral orifice was still inflamed and swollen. Cystoscopic examination on May 22, 1944, revealed less congestion of the left orifice, and a catheter was easily passed up the left ureter. The stone shadow was still present in the left pelvis, but no stone or obstruction was found in the lower ureter.

On June 2, 1944, a left ureterolithotomy was performed and a  $10 \times 5 \times 5$ -mm stone was removed from the ureter just below the left ureteropelvic junction. Convalescence was uneventful. Excretory urograms on June 17, 1944, were normal.



Fig 5 Case 2 Fifteen-minute urogram showing a positive nephrogram on the right side. The calculus shadow is in the lower right pelvis.

(Fig 4) The patient was discharged to duty on July 8, 1944.

**Comment** In this case the excretory urographic study was done after the presence of a block had been established following an attempt to catheterize the left ureter. Clinically, the symptoms pointed to a low obstruction, and this was confirmed by catheterization. However, when the stone at the ureteropelvic junction was noted on the plain film, it was also considered as a possible cause for the obstruction. The twenty-four-hour study clearly showed that the block was due to the obstruction in the lower left ureter and not to the stone in the upper tract, thus confirming the clinical impression.

**CASE 2** A twenty-two-year-old white soldier was admitted to the hospital on May 5, 1944, at 3:00 A.M. He had felt well until the night before, when he experienced an aching pain in the right kidney region, which did not subside and subsequently became more severe. There was no radiation of the pain nor was any change noted in the color of the urine. A stone had been removed from



Fig 4 Case 1 Urographic study after removal of stone Fifteen-minute urogram before release of compression Note that the collecting systems on both sides are equally outlined as compared to Fig 2

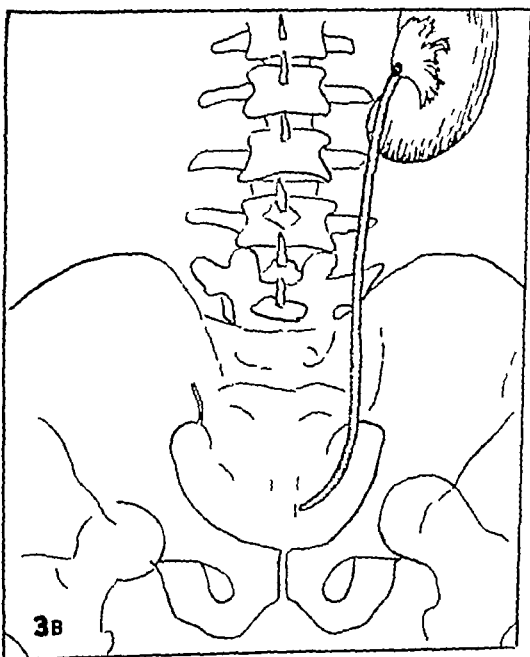


Fig 3, A and B Case 1 A Twenty-four-hour urogram The entire collecting system on the left side is well outlined to the point of obstruction Note the calculus shadow at the left ureteropelvic junction B Sketch illustrating the extent of the delineation

twenty-four hours after the injection of the dye Earlier studies failed to establish the point of block, but in each instance the collecting system and ureter on the affected side were clearly outlined to the site of obstruction in the twenty-four-hour study In one case the shadows were still present at forty-eight hours We are reporting the findings and clinical courses in these three cases to illustrate the value of twenty-four-hour excretory urograms in acute ureteral obstruction

#### CASE REPORTS

CASE 1 A 38-year-old white married soldier entered the hospital on May 4, 1944, complaining of soreness in his left side and scrotum for twenty-four hours before admission During that time there was an acute episode with sudden radiation of pain from the left loin to the left scrotum The patient went to the Dispensary and was given some medication for relief, there was no blood in the urine He went to bed but did not feel well The following afternoon he had another acute attack, which required morphine, and he was admitted shortly thereafter

In the last few months we have had three cases in which an examination was made

The physical examination revealed no gross abnormalities. The temperature was 99°. There was pain in the left loin and costovertebral angle on deep pressure and percussion. The urine now contained many red blood cells. Sedatives and fluids were prescribed.

Cystoscopy was done the morning of May 5, 1944. A catheter was placed in the left ureteral orifice and an obstruction was met just beyond (Fig 1). Attempts to pass a bougie, a Johnson basket, and a stone dislodger were all unsuccessful. Following this, the upper leaf of the left ureteral orifice was incised with cystoscopic scissors.

After the cystoscopy, excretory urograms were made. The preliminary plain abdominal film showed both kidneys outlined in normal position. There was a  $7 \times 5$ -mm shadow of calcific density in the region of the left ureteropelvic junction, and several phleboliths were seen on both sides of the pelvis, but no stone was demonstrable at the site of the obstruction in the lower left ureter. Studies made at five and fifteen minutes showed a positive nephrogram on the left with no dye in the collecting system (Fig 2). The right side was normal. The studies were not carried beyond thirty minutes at this time.

At twenty-four hours an abdominal film showed the left pelvis, calices, and ureter well outlined to a point just above the ureterocystic junction, which was where the obstruction was found when the left ureter was catheterized the day before (Fig 3, A and B). The calculus previously noted in the region of the left ureteropelvic junction had not changed its position. Similar findings were noted at forty-eight hours, but the density of the collecting system was much less, indicating that partial drainage had occurred. It was felt that the block was due either to a non-opaque stone or to stone fragments too small to be visualized.

Another excretory urogram was made on May 8, 1944, three days after the first examination. A positive nephrogram was again obtained on the left side. The twenty-four-hour study, however, did not show any accumulation of the contrast substance in the collecting system, indicating that the block was not so great as at the time of the examination three days before.

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On June 2, 1944, a left ureterolithotomy was performed and a  $10 \times 5 \times 5$ -mm stone was removed from the ureter just below the left ureteropelvic junction. Convalescence was uneventful. Excretory urograms on June 17, 1944, were normal.



Fig 5 Case 2 Fifteen-minute urogram showing a positive nephrogram on the right side. The calculus shadow is in the lower right pelvis.

(Fig 4) The patient was discharged to duty on July 8, 1944.

*Comment* In this case the excretory urographic study was done after the presence of a block had been established following an attempt to catheterize the left ureter. Clinically, the symptoms pointed to a low obstruction, and this was confirmed by catheterization. However, when the stone at the ureteropelvic junction was noted on the plain film, it was also considered as a possible cause for the obstruction. The twenty-four-hour study clearly showed that the block was due to the obstruction in the lower left ureter and not to the stone in the upper tract, thus confirming the clinical impression.

**CASE 2** A twenty-two-year-old white soldier was admitted to the hospital on May 5, 1944, at 3:00 A.M. He had felt well until the night before, when he experienced an aching pain in the right kidney region, which did not subside and subsequently became more severe. There was no radiation of the pain nor was any change noted in the color of the urine. A stone had been removed from

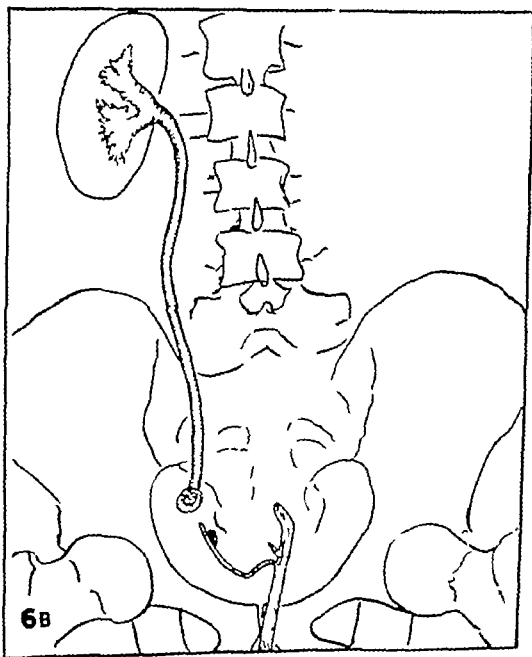


Fig 6, A and B. Case 2. A. Twenty-four-hour urogram. Note the bulbous end of the dilated right ureter and the tip of the catheter at the site of the stone 3 cm below the ureteral block. The collecting system is dilated and outlined as far as the diverticulum. B. Sketch illustrating the extent of the delineation.

the lower right ureter at another Army General Hospital on Feb 10, 1944. Convalescence had been uneventful and the patient had returned to duty on March 25. This was the first attack of pain experienced since then.

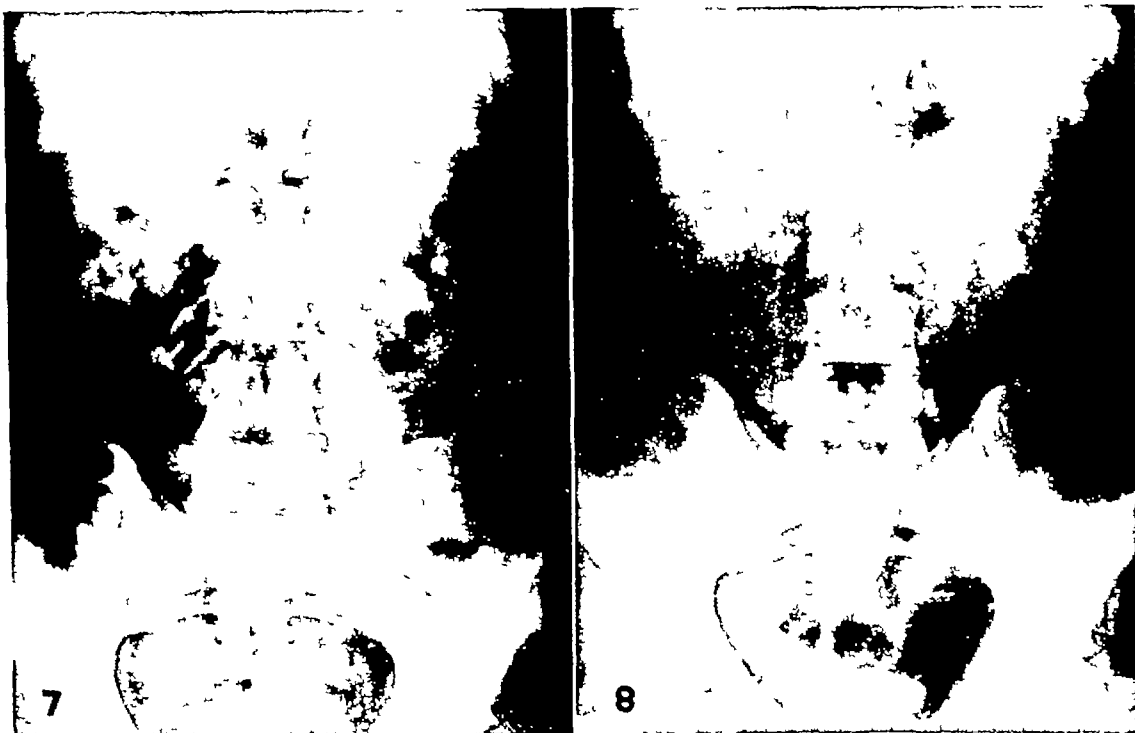
Physical findings were not significant except for a scar in the right lower quadrant from the previous extraperitoneal ureterolithotomy. The temperature on admission was  $99.6^{\circ}$ . A few red cells were present in the urine.

Shortly after admission, a plain abdominal film showed a  $5 \times 3$ -mm calculus shadow in the right lower ureter just above the ureterocystic junction. Thirty cubic centimeters of diodrast were administered and the examination was carried out over a period of forty-five minutes. Normal function and a normal pyelogram were seen on the left side. On the right side there was a positive nephrogram but no dye was seen in the collecting system over the period of forty-five minutes (Fig 5).

The following morning cystoscopy was performed and a catheter was inserted into the right lower ureter for a distance of 4 to 5 cm, when a block was encountered. The tip of the catheter was along side the calculus. This was approximately twenty-four hours after the administration of the dye. At this time the right collecting system was well outlined to a point just below the lower border of the sacrum, 3 cm above the calculus shadow. There were a moderate hydronephrosis and hydroureter (Fig 6, A and B). The end of the dilated ureter was bulbous, probably due to a small diverticulum at the site of the previous ureterotomy. The following day, that is forty-eight hours after the injection of the dye, the pelvis and kidney were still faintly outlined by the contrast substance. At this time the diverticulum in the lower ureter was larger, but the stone shadow below it had not changed its position (Fig 7).

The patient continued to have some fever, his temperature going as high as  $102^{\circ}$  on May 7. On May 8, an attempt was made to remove the calculus by ureteral manipulation through the cystoscope. This was unsuccessful and, immediately following this failure, an extraperitoneal ureterolithotomy was attempted. Due to the previous operation, however, the scar tissue was so dense that proper tissue cleavage was not obtained and the ureter could not be identified. A cystotomy was then performed, but the stone could not be found. A tube was left in the bladder. Convalescence was uneventful. On May 14, 1944, the stone passed spontaneously and a plain film showed no other calculi.

Check excretory urograms were made on May 26, 1944, and a normal pyelogram was obtained on the right side, with no evidence of delay in passage through the ureter. At the site of the large diverticulum previously noted, a small pouch filled with contrast substance still revealed itself, but the ureter below this to the ureterocystic junction was well outlined (Fig 8).



Figs 7 and 8 Case 2

Fig 7 Forty-eight-hour urogram The collecting system on the right is still faintly outlined, but the diverticulum at the site of the ureteral obstruction is larger The calculus below it is still present

Fig 8 Fifteen-minute urogram twelve days following spontaneous passage of the stone. Note the normal pyelogram and the outlining of the lower right ureter as well as the persistent small diverticulum

The patient was discharged to duty on June 16, 1944

*Comment* In this case the obstruction as established by the twenty-four-hour urogram was at the site of the diverticulum which had developed after the previous ureterolithotomy, even though, by retrograde examination, the ureteral catheter was found to be blocked by the small stone just above the ureterocystic junction, which was 3 cm below the site of the actual obstruction In all probability the clinical symptoms were due to the block at the site of the diverticulum and not to the passage of the stone down the ureter

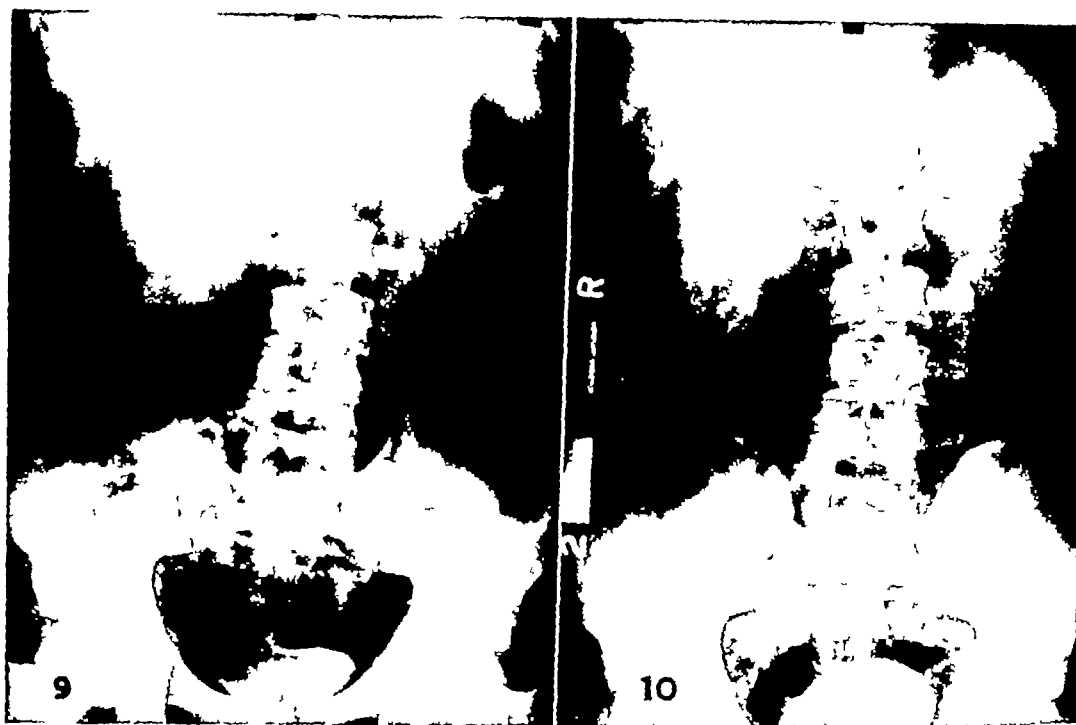
**CASE 3** A thirty-four-year-old white soldier was admitted on June 15, 1944, with a diagnosis of right ureteral colic The night before admission he had experienced right lumbar pain, which became quite severe and radiated to the right testicle There had also been some nausea and vomiting

Pain was present on pressure over the right loin and kidney area The temperature was normal A few red cells were found in the urine

Shortly after admission, excretory urograms were made The preliminary plain film showed no evidence of opaque stone in the urinary tract A positive nephrogram was observed within fifteen minutes on the right side, but there was no evidence of any dye in the collecting system (Fig 9) The left pyelogram and ureterogram were normal Examinations at two (Fig 10) and seven hours showed rather marked hydronephrosis on the right, but the ureter was still not outlined The twenty-four-hour examination, however, outlined the entire right ureter, which was dilated as far as the ureterocystic junction, where there was an obstruction (Fig 11, A and B)

A cystoscopy was performed on June 17, 1944, two days after admission, and a catheter was passed as far as the right kidney pelvis No obstruction was encountered The catheter was left in place for twenty-four hours

A second excretory urogram was made on June 20, 1944, five days after the original study Both sides revealed good function at five minutes and well outlined pyelograms were seen at fifteen minutes At this time there was still some pyelectasis and evidence of moderate hydronephrosis on the right, but there had been a marked improvement since the examination of five days before (Fig 12)



Figs 9 and 10 Case 3

Fig 9 Fifteen minute urogram showing a positive nephrogram on the right side. The right kidney is slightly larger than the left

Fig 10 Two hour urogram The pelvis and calices on the right are faintly outlined revealing a hydronephrosis

The patient was discharged to duty on June 28, 1944

*Comment* In this case the exact cause for the obstruction at the ureterocystic junction was not determined. The hydronephrosis and hydroureter observed at the twenty-four-hour examination indicated that the block had been present for some time. There was relief from pain following catheter drainage of the obstruction, and the patient made an uneventful recovery. Following relief of obstruction, a check-up study within five days showed a marked improvement in the degree of hydronephrosis.

#### DISCUSSION

The phenomenon of the positive nephrogram associated with ureteral obstruction was noted by Wilcox (1). His experiments on rabbits showed that a block of the ureter must be present about sixty minutes before any accentuation of the kidney shadow oc-

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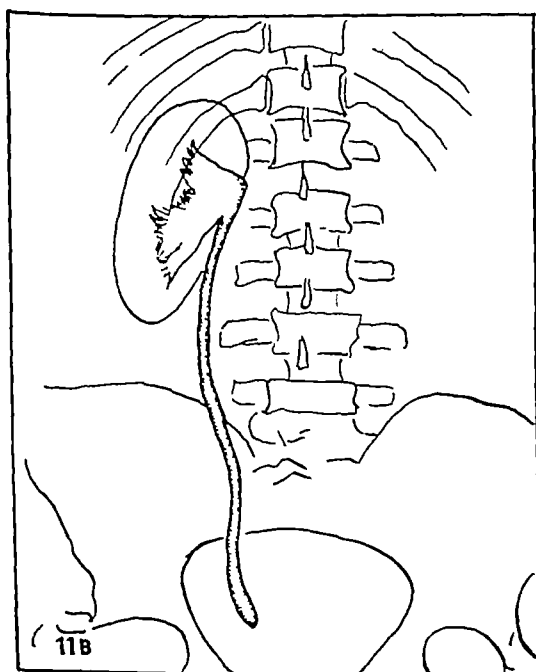


Fig 11, A and B Case 3 A Twenty-four-hour urogram The slightly dilated ureter is outlined as far as the ureterocystic junction Note the well marked hydronephrosis B Sketch illustrating the extent of the delineation

Fig 12 Case 3 Fifteen-minute urogram four days following Fig 11 The obstruction had been relieved three days before Note the equal excretion time on both sides There is still some hydronephrosis on the right, especially pyelectasis

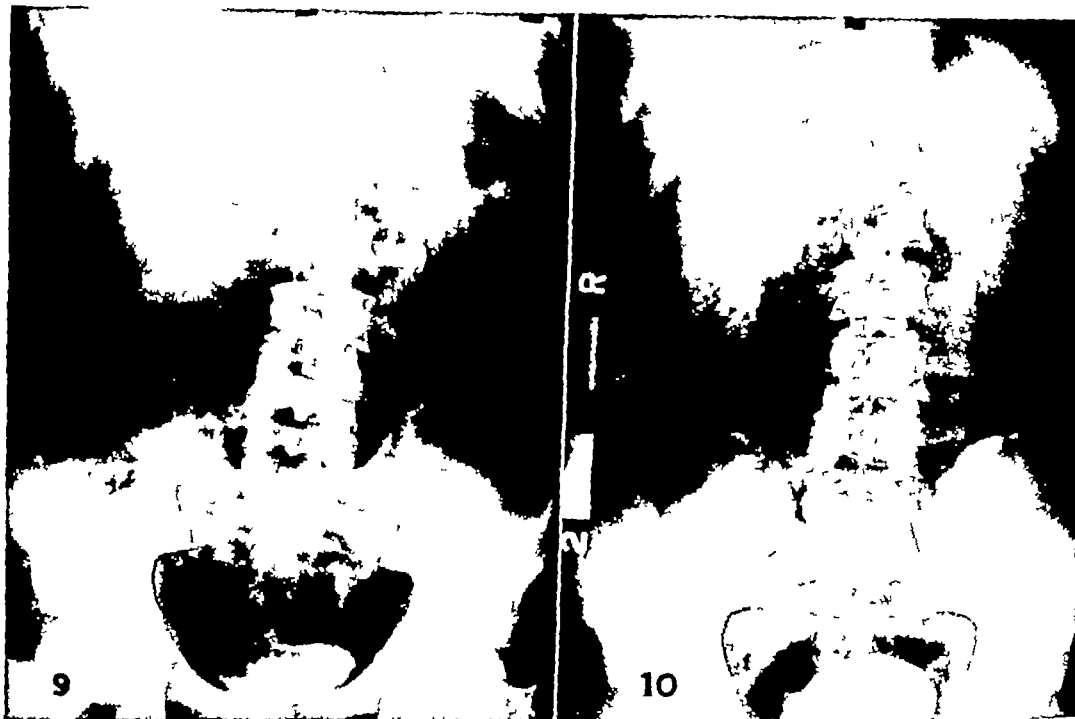
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In this department, each film is viewed immediately by the radiologist, and when there is a suppression of function, examinations are carried on at intervals of one to four hours If the collecting system is not outlined to the point of obstruction after six to eight hours, another study is not made until twenty-four hours

It should be emphasized that the clinical state should determine whether a patient with acute ureteral obstruction should be studied by excretory or by retrograde urography Excretory studies are indicated if a block has been found following

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Figs 9 and 10 Case 3

Fig 9 Fifteen-minute urogram showing a positive nephrogram on the right side. The right kidney is slightly larger than the left

Fig 10 Two-hour urogram The pelvis and calices on the right are faintly outlined, revealing a hydronephrosis

The patient was discharged to duty on June 28, 1944

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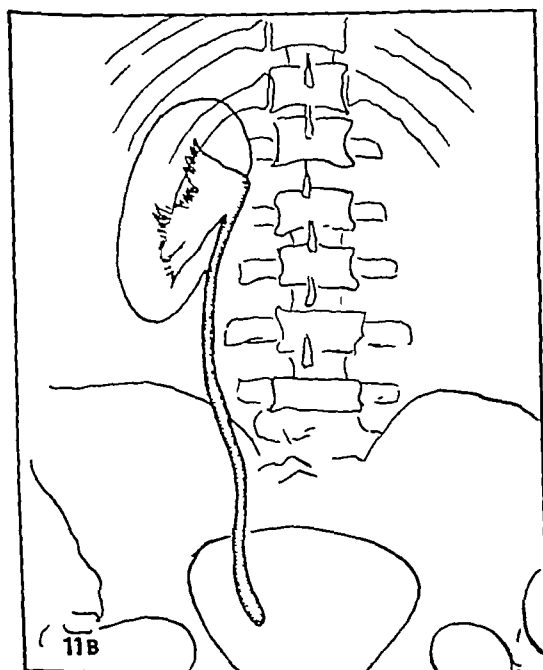


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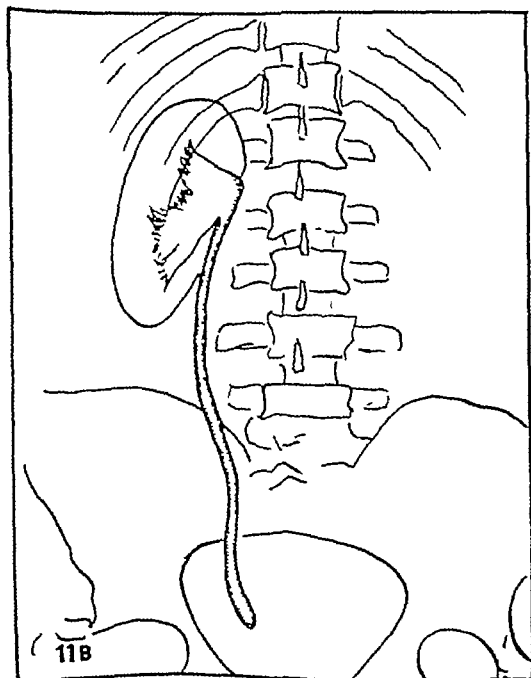


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ureteral catheterization or if the plain film shows a stone and a block is suspected (2). For complete evaluation of the clinical state, the affected urinary tract should be outlined to the point of obstruction if possible. When a delay in excretion is observed on the excretory urograms, it may be necessary to carry the examination over a period of several hours and, as illustrated by the case reports, an examination at twenty-four hours may give complete and valuable information which was not obtained with earlier studies.

#### CONCLUSION

Three cases of ureteral obstruction have been reported in which a twenty-four-hour

excretory urogram gave accurate information as to the exact site of the obstruction. The value of this delayed examination in excretory urography in general and its usefulness in cases of ureteral obstruction in which the exact site of obstruction had not been determined by the earlier urograms or by a retrograde examination have been discussed.

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# Pulmonary Calcifications Roentgenographic Observations in Relation to Histoplasmin and Tuberculin Reactions<sup>1</sup>

HENRY B ZWERLING, Surgeon (R) and CARROLL E PALMER, Surgeon

U S Public Health Service, Field Studies Section, Tuberculosis Control Division, Bethesda 14, Md

IT HAS RECENTLY been reported by one of the authors (1) that in the central eastern portion of the United States pulmonary calcification is more frequently associated with sensitivity to histoplasmin than to tuberculin or coccidioidin sensitivity. It is therefore important to re-evaluate the current concept of tuberculosis as the only significant cause of calcification in the lungs.

In recent years pulmonary calcification in tuberculin-negative persons has been demonstrated to be prevalent in the central eastern states—Kentucky, Arkansas, Illinois, Indiana, Iowa, Maryland, Mississippi, Missouri, North Carolina, Ohio, Tennessee, Virginia, and West Virginia (2-8). Infectious agents other than the tubercle bacillus have been considered as the possible causative factor. Olson *et al* (7) sought but were unable to demonstrate a relationship to ascariasis. Aronson *et al* (9) presented strong evidence in favor of coccidioidomycosis as the factor responsible for much of the pulmonary calcification found among Indians in the Southwest. Smith (10) has pointed out that the area of prevalence of tuberculin-negative pulmonary calcification corresponds with the endemic area of histoplasmosis, a fungous disease usually fatal. This is supported by a recent review (11) of 56 cases which have been recognized in this country.

The present study is based on the data reported by Palmer (1), together with additional material which has since been collected as part of a co-operative project conducted by the National Tuberculosis Association, the U S Public Health Service, and a large number of schools of nursing throughout the country. Roent-

genograms and the results of tuberculin and histoplasmin<sup>2</sup> skin tests are available for 6,199 student nurses in 8 large cities. From Table I it is evident that the inci-

TABLE I PULMONARY CALCIFICATION IN STUDENT NURSES, WITH POSITIVE HISTOPLASMIN AND POSITIVE TUBERCULIN REACTIONS

City	Percentage of Student Nurses		
	With Calcification	With Histoplasmin Reaction*	With Positive Tuberculin Reaction†
Kansas City, Mo	24 3	66 6	26 3
Columbus, Ohio	21 3	62 0	20 7
Kansas City, Kans	20 4	53 1	29 5
Baltimore, Md	10 9	27 0	29 7
New Orleans, La	7 9	24 4	27 0
Philadelphia, Pa	7 4	14 4	26 6
Detroit, Mich	6 6	14 7	22 2
Minneapolis, Minn	2 3	6 5	16 3

\* Positive and doubtful

† The population on which the tuberculin reactions are based is larger than in the other two columns, representing all student nurses tested with tuberculin in the various cities.

dence of pulmonary calcification shows a wide variation geographically—from 24.3 per cent in Kansas City, Mo., to 2.3 per cent in Minneapolis. The positive reactions to histoplasmin are closely parallel in distribution to the calcification, whereas no such parallel with positive tuberculin reactions was apparent in this material. For example, the level of tuberculin sensitivity was approximately the same in Kansas City, Mo., as in Philadelphia, 26.3 and 26.6 per cent, respectively. On the other hand, four times as many student nurses showed calcification in Kansas City as in Philadelphia, and over four times as many were sensitive to histoplasmin. Of 532 subjects with tuberculin-negative pulmonary calcification in the entire group of cities, all but 38 (5.4 per cent) were histo-

<sup>1</sup> Accepted for publication in August 1945.

<sup>2</sup> The dose of histoplasmin used in this study was 0.1 cc of a 1:1,000 dilution of the filtrate of a broth culture of *Histoplasma capsulatum*.

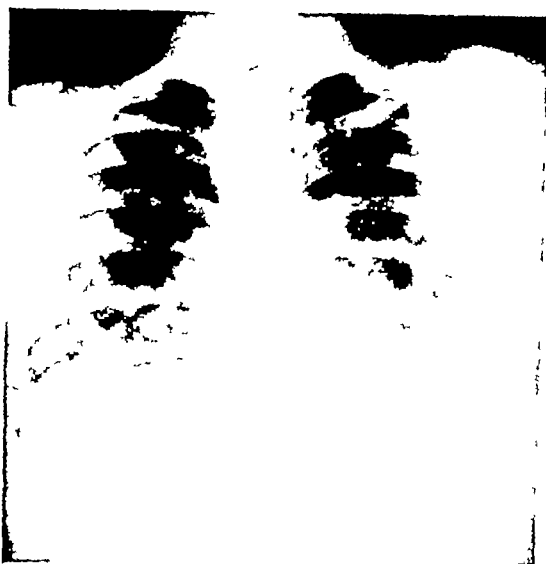


Fig 1 Multiple bilateral calcification, miliary type, tuberculin-negative, histoplasmin-positive

plasmin-positive. It is strongly suggestive that *Histoplasma capsulatum* or some immunologically related organism is responsible for the majority of instances of pulmonary calcification in regions such as Kansas City and Columbus, Ohio.

#### ROENTGENOLOGIC FINDINGS

There are no generally accepted criteria for the recognition of pulmonary calcification; the variation among different roentgenologists is extreme. Irregularity of outline, sharpness, and opacity are important considerations. Oval or round areas of density, when close to the hilum or to the lung bases, are difficult to interpret since they could possibly represent vascular markings. Round dense shadows in the periphery of the lung fields can be interpreted as calcification when the diameter exceeds that which would be expected of vascular markings in these areas.

In this study all films were reviewed by one person without knowledge of the tuberculin or histoplasmin reactions. Calcification was designated as definite, probable, or questionable. The *definite* category included calcification in which the size, density, sharpness, and irregularity of outline were so striking as to be regarded as unquestionable. *Probable* calcification

represented those shadows which were less definite than in the preceding group, but of such density and configuration as to seem to exclude vascular structures and calcifying costal cartilages. In many instances of this type the decision was made simpler by the availability of several films of the same subject. The *questionable* group embraced all shadows which could conceivably represent calcification but which the interpreter assumed were vascular or otherwise normal.

It was not possible to obtain oblique or lateral projections or to do roentgenoscopy, which would have been of great aid in differentiating vascular markings from calcification. In many instances several films were available for individual subjects; in those instances the finding of calcification was accordingly more definite and more accurate.

Since the primary purpose of the study was to detect the early tuberculous lesions, the hilar zone was relatively underexposed; calcification was probably not infrequently missed in these areas, but this error is constant throughout the series. Because of the criteria established in this study, it may well be that a number of instances of pulmonary calcification were not included.

A total of 6,199 student nurses were examined by roentgenography and tested with tuberculin and histoplasmin. Of this number, 698 showed pulmonary calcification. Among this group of 698 it was found that 57 were tuberculin-positive, 494 were histoplasmin-positive, and 109 had positive reactions to both tuberculin and histoplasmin. Of the 698 subjects with definite or probable calcification, only 38 (5.4 per cent) were negative to both tuberculin and histoplasmin. Little association could be found between questionable calcification and sensitivity to either antigen. This would be expected if vascular markings or other normal structures were placed in this category. The calcification discussed in this report, therefore, includes only the definite and probable categories.



Fig 2 Massive hilar calcification and bilateral small calcific nodules, tuberculin-negative, histoplasmin-positive

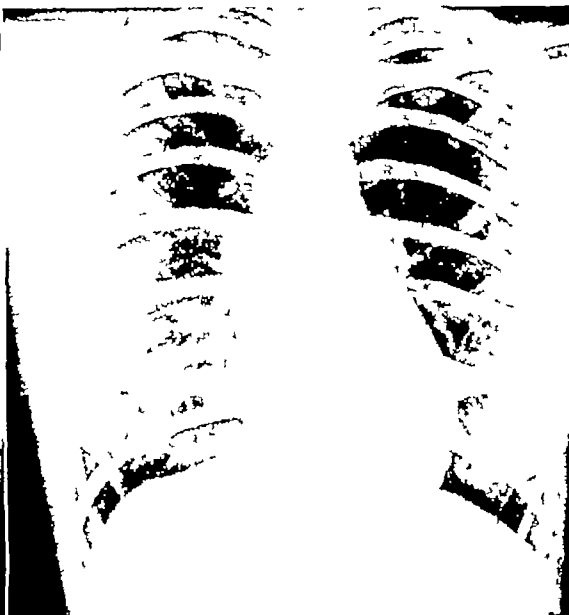


Fig 3 Calcified primary complex, right second interspace anteriorly, tuberculin-negative, histoplasmin-positive

An attempt was made to differentiate between calcification presumably due to tuberculosis (positive tuberculin, negative histoplasmin reactions) and that presumably due to histoplasmosis or an immunologically similar disease (positive histoplasmin, negative tuberculin reactions). The lung fields were divided into upper, middle, lower, and hilar zones and the number of instances in each group was noted. The calcareous deposits were also classified into various categories of individual size, shape, regularity of outline, homogeneity, and uniformity. The total number of separate calcific deposits seemed to be greater in histoplasmin-positive subjects than in those who were tuberculin-positive, but it is doubtful if this finding can be applied in the individual instance. In general, no striking or characteristic features of individual lesions have been seen thus far which would be of value in the differentiation between tuberculin-positive and histoplasmin-positive calcification except for instances of scattered multiple bilateral calcification, including the miliary type. In this series there were 15 instances of this kind (Fig 1), of which 13 were tuberculin-negative and 2 tuberculin-

positive, 14 were histoplasmin-positive and 1 was negative to both antigens. With so small a series, definite conclusions cannot be drawn, but it is possible that histoplasmosis or an immunologically similar disease accounts for many instances of this type.

Massive calcification in the hilar zones has frequently been considered pathognomonic evidence of a healed primary tuberculous complex (12). Of 57 instances in which the calcification measured 2 cm or more in diameter, 3 were tuberculin-positive only, 8 were tuberculin- and histoplasmin-positive, and 44 were histoplasmin-positive and tuberculin-negative. In 2 instances there was no sensitivity to either antigen. It is evident, therefore, that large single areas of calcification need not represent previous tuberculous infection.

#### DISCUSSION

There is little reason to assume that loss of tuberculin allergy or absorption of calcified lesions can account for the striking geographical distribution of the roentgenographically demonstrated pulmonary calcification.

The association of histoplasmin sensi-



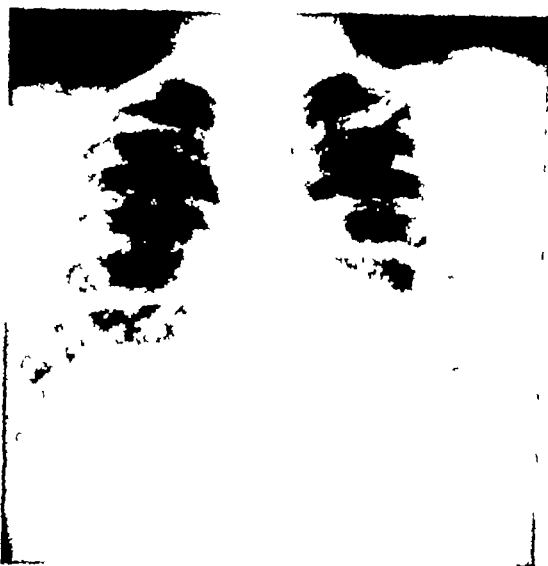


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tivity with calcification does not prove beyond doubt that *Histoplasma capsulatum* is the organism responsible for the findings, for we have not had the opportunity to follow bacteriologically proved lesions from inception to healing with calcareous deposition. In addition, since cross sensitivity must be considered, it is possible that an immunologically related organism may be responsible (10).

If the histoplasmin reaction is specific for infection by *Histoplasma capsulatum*, it will be necessary to abandon the concept of histoplasmosis solely as a disseminated disease involving the reticulo-endothelial system, lungs, skin, mucous membranes, suprarenal glands, and gastro-intestinal tract. By analogy with tuberculosis and coccidioidomycosis, it is probably fair to assume that in the great majority of instances histoplasmosis is a benign disease and only in the exceptional case will dissemination occur. Since the transient mild symptoms of the benign forms of tuberculosis and coccidioidomycosis are frequently unnoticed, it is only by skin testing that most instances of previous infection are discovered.

Pulmonary calcification is an end-result of a disease process, until the disease shall have been studied from the early infection to the stage of calcification, it is possible only to draw inferences concerning the nature of the active phase. In the many instances of healed primary complexes of the type usually considered typical of tuberculosis, it was not possible to distinguish between those with positive histoplasmin and tuberculin reactions. Furthermore, the end-result of calcification in the lungs and hilar lymph nodes suggests that the active phase will frequently mimic primary tuberculosis in childhood, with a focus in the lung parenchyma and involvement of the hilar lymph nodes. Massive involvement of lymph nodes is not infrequent, since in 44 instances of calcification in the lymph nodes measuring 2 cm or more, the histoplasmin reaction was positive and the tuberculin reaction negative. In addition,

it is probable that the diagnosis of reinfection tuberculosis based on the finding of calcification in association with active tuberculosis is not always justified.

It is possible that in certain states, as Missouri, Kansas, and Ohio, tuberculosis is diagnosed more frequently than is warranted. In this study of student nurses several instances have been encountered of exudative minimal lesions which could not be distinguished from tuberculosis, but in which the tuberculin reaction has remained negative, and the histoplasmin reaction has been positive. An opportunity has not yet been afforded to determine conversion of the reaction to histoplasmin from negative to positive.

#### SUMMARY

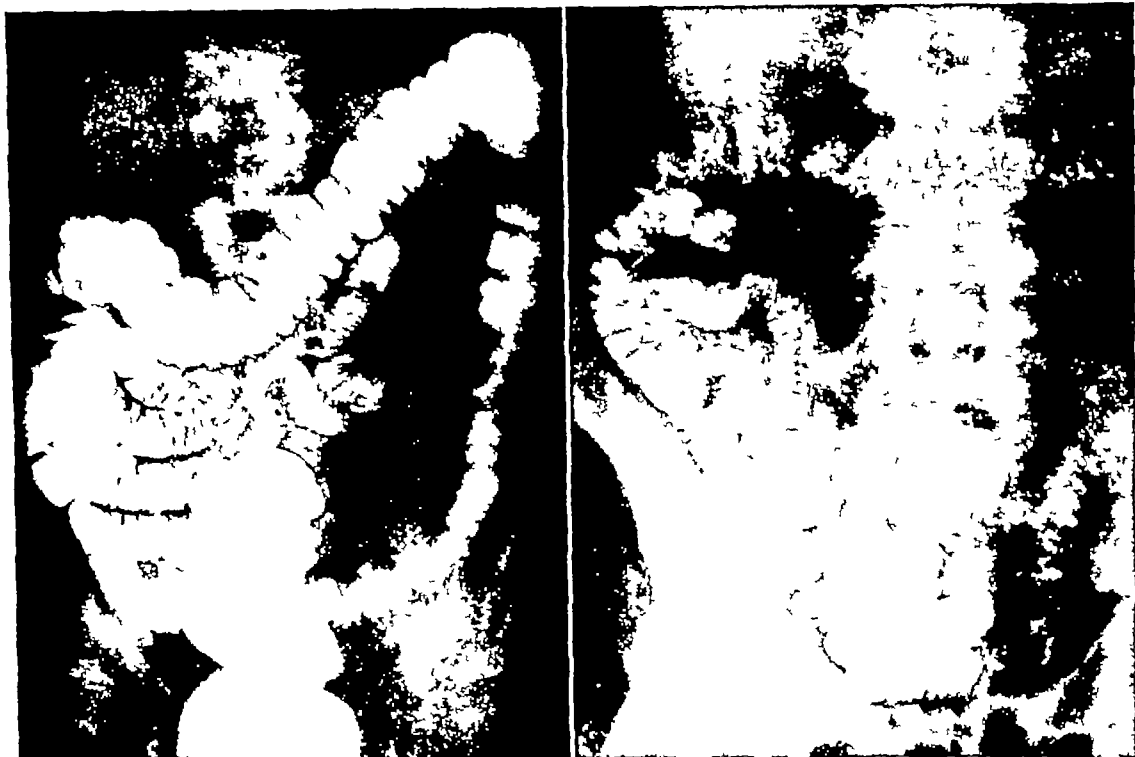
In a study of 6,199 student nurses, 698 instances of pulmonary calcification were observed.

Evidence has been presented to indicate an association between pulmonary calcification and sensitivity to histoplasmin in the central eastern states of this country. It is likely that this sensitivity is an indication of previous infection with the fungus *Histoplasma capsulatum* or an immunologically related organism, and that infection with these organisms is not necessarily serious or fatal but is widespread in sub-clinical form.

Since in most instances it has not been possible to distinguish between tuberculin-positive and histoplasmin-positive calcification, it may be inferred that during the active phase of the infection the roentgenographic appearance of the benign form of histoplasmosis can resemble tuberculosis. Consideration of the tuberculin reaction and the recovery of the tubercle bacillus is therefore essential for the final diagnosis of pulmonary tuberculosis. This in no sense implies mis-diagnosis in the majority of instances of pulmonary tuberculosis, but is merely an urge to greater caution.

The authors are deeply indebted to Lydia B. Edwards, Surgeon (R), U. S. Public Health Service, for stimulation in this study.

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Figs 1 and 2 Case of *Taenia saginata* infestation. Fig 1 (on the left) made following the administration of a barium enema, shows a long ribbon-like filling defect representing the beef tapeworm in the ileum. The irritable descending colon and diverticulitis are also demonstrated. Fig 2, made following evacuation of the enema, again shows clearly the ribbon-like defect in the ileum.

of greater value than a barium enema in diagnosing the presence of the parasites. Had not the tapeworm been found when barium flowed into the small intestine through the ileocecal valve, the patient's symptoms would have justified a small bowel series, since the diverticulitis could not have accounted for the severe weight loss, in addition to the diarrhea. One of the criteria given by Golden (2) as an indication for a small bowel series is diarrhea unexplained by studies of the colon.

Archer and Peterson (1) and others have reported the roentgenologic criteria for diagnosing the presence of *Ascaris lumbricoides* in the small intestines. The differential diagnosis, it is believed, can be made roentgenologically. *Taenia saginata* causes a ribbon-like filling defect, which is much longer than the defect caused by *Ascaris*. After evacuation, the double track outline, often seen in the presence of ascariasis, was not seen in this case and probably would not be seen in

similar cases, due to the structure of the cestode. Other types of tapeworm, it is believed, would cause filling defects in the small bowel not unlike those produced by *Taenia saginata*.

#### SUMMARY

Attention has been called to the possibility of diagnosing *Taenia saginata* roentgenologically prior to laboratory confirmation. The roentgen findings have been discussed. A case of intestinal infestation has been reported.

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# Taenia Saginata A Case Report<sup>1</sup>

LT COL. JOHN B HAMILTON, M.C., A U S

**T**APEWORM infestation has previously been demonstrated roentgenologically Penfold and Penfold (3) consider the roentgen demonstration more interesting as a scientific curiosity than a practicable means of diagnosis It is believed, however, that occasionally a roentgenologic diagnosis of *Taenia saginata* will be of practical value

The beef tapeworm is found wherever beef is eaten Strong (4) reports that "it is the commonest large tapeworm of man, next to *Hymenolepis nana*, in the United States

In some localities, as in Africa and Syria, and also among the Tibetans, one-fourth to three-fourths of the inhabitants are reported as infested

The adult worm is found in the proximal part of the small intestine It is from four to eight meters long and is made up of several hundred (up to 2,000) segments

"When infected meat is eaten raw or inadequately cooked, the cyst wall is dissolved, the scolex attaches itself to the intestinal wall and grows rapidly, reaching the adult stage after about two months The maximum duration of life is not known, but is at least several years "

## CASE REPORT

The patient, aged sixty, was a tall, thin, emaciated white male, older in appearance than his stated age His chief complaint was severe weight loss He had been accepted for general service in August 1940 In May 1942, he was sent to Persia, where he experienced a chronic feeling of fatigue and began to lose weight Thus, in his opinion, was incident to sweating associated with the excessive heat In August 1942, he suffered an attack of sandfly fever During his stay in Persia, there were no specific gastro-intestinal symptoms except for occasional mild bouts of diarrhea due, he believed, to poor food His symptoms continued, but he was not incapacitated, although he lost approximately 65 pounds In January 1943, he returned to the United States, where during a thirty-day leave he regained 18 pounds Following this, during an assignment in this coun-

try, he continued slowly to regain weight In 1944, he was again found fit for overseas duty and in March departed for India

Shortly after arrival, he began to suffer from anorexia, occasional mild lower abdominal cramps, and constipation, at times alternating with mild diarrhea He attributed the symptoms to eating excessively greasy food He began again to lose weight rapidly The symptoms persisted, and by early July (1944) he had lost approximately forty five pounds He was returned to the United States. En route to the boat, his gastro-intestinal symptoms improved, due to the change in diet After several weeks on board ship, a moderate painless edema of the feet and ankles developed, which improved after arrival in America

Shortly after admission to this hospital, a barium enema study was performed, at which time the ileocecal valve failed to relax A spastic, irritable colon and a sigmoid diverticulitis were reported Additional gastro-intestinal studies were suggested

Routine laboratory studies were non contributory The sedimentation rate was within the limits of normal One stool examination was made and the feces were reported negative for parasites, ova, and occult blood The blood count, urinalyses, and blood chemistry were within normal limits There was no eosinophilia

On Nov 27, the patient brought in a proglottis which he had found in his feces, which was identified as that of *Taenia saginata* On the following day, another barium enema was given The ileocecal valve relaxed and the barium flowed freely into the ileum A long ribbon-like defect, consistent with the presence of *Taenia saginata*, was well demonstrated in the ileum (Fig 1) The descending colon was irritable and spastic, and evidence of a moderate sigmoid diverticulitis was again obtained Following evacuation of the enema, the terminal end of the beef tapeworm in the ileum was clearly shown (Fig 2)

## DISCUSSION

*Taenia saginata*, the beef tapeworm, when present in human intestines, may be diagnosed roentgenologically, and the finding may be of diagnostic importance since a routine stool examination may fail to reveal evidence of the condition Our patient was treated before a small bowel series could be performed Such an examination, it is believed, would usually be

<sup>1</sup> Accepted for publication in August 1945



Fig 1 Adenoid hyperplasia with moderate encroachment on breathing space

#### DIAGNOSIS

Although the clinical diagnosis of adenoid vegetations in the epipharynx is not difficult, the roentgenologist can be of considerable help to the general practitioner, pediatrician, and rhinologist, who see the majority of cases. Usually there is a history of lassitude, poor appetite, weight loss, pallor, lack of interest in games, and easy fatigue. Hyperplasia of the adenoids can be suspected in typical cases from the so-called adenoid facies, difficulty of respiration through the nose, sleeping with an open mouth, disturbances of phonation and hearing, and a predisposition to upper respiratory infections, otitis media, and mastoiditis.

Anterior and posterior rhinoscopy cannot be carried out in the great majority of cases, because of difficulty in getting cooperation from young patients. Palpa-

tion of the adenoids through the mouth not only induces physical trauma but may also produce psychic trauma. Even if palpation can be done on a co-operative patient, there are variations in personal opinions as to the amount of adenoid tissue present. Under these conditions it is felt that the roentgen examination can be depended upon to give an accurate diagnosis as to the presence or absence of abnormal soft tissue shadows in the epipharynx, at the same time obviating the disadvantages of physical examination with the finger or by rhinoscopy, while postoperative roentgen studies furnish a check on the thoroughness with which the epipharynx has been cleaned out.

In the X-Ray Department at the Munson Hospital we routinely take a lateral view of the epipharynx in all cases referred with requisitions asking for examina-

# Roentgenography of Adenoids<sup>1</sup>

HARRY L. WEITZ, M D

Traverse City, Mich

IN THESE DAYS of rapid advances in diagnostic technic we are inclined to overlook the value of the x-ray film in the diagnosis of simple ailments. Scanning the literature, one is impressed with the paucity of articles dealing with lesions of the epipharynx, particularly adenoids. Pancoast, Pendergrass, and Schaeffer (4) briefly mention adenoids in their excellent textbook. Young (5) passes them off with a few sentences. Adenoid vegetations were pointed out on the roentgen film as early as 1898 by Mignon (Paris). Grandy (1) gave a roentgenographic description of adenoids in 1925, and Groth (2) submitted a comprehensive paper on the roentgen aspects of the epipharynx and adenoids in 1933.

## ANATOMY

The pharynx is a vertical musculomembranous passage, flattened anteroposteriorly, extending from the base of the skull above to the beginning of the esophagus below. Posteriorly it is in relationship with the cervical vertebrae, laterally, with the internal and common carotid arteries, the internal jugular vein, the sympathetic and last four cranial nerves. Anteriorly it communicates above with the nasal cavity, beneath this with the oral cavity, and below with the laryngeal cavity.

The pharynx is divided into three parts: the nasopharynx or epipharynx, which, according to the anatomical textbooks, is exclusively respiratory in function, the oropharynx, which is both respiratory and alimentary, and the laryngopharynx, which is almost entirely alimentary. On the ventral wall of the nasopharynx are the two choanae (posterior nares), separated by the vomer of the nasal septum. The floor of the nasopharynx is the upper

surface of the soft palate. Above and behind bilaterally on the lateral wall is located the pharyngeal recess (fossa of Rosenmüller), while below and in front on the lateral walls are found the openings of the eustachian tubes and their elevated boundaries. The posterior wall of the nasopharynx slopes forward above the level of the anterior arch of the atlas to become confluent with the roof or fornix of the pharynx. The mucosa of the fornix—and to a certain extent, also, the posterior wall—especially in children, is thrown into numerous folds which contain much lymphoid tissue, both diffuse and in the form of numerous characteristic nodules with crypt-like invaginations of the surface epithelium. This area constitutes the pharyngeal tonsil, or adenoids. According to Symington, the involution of the adenoids begins at about six to seven years and is usually completed at ten years.

When the patient is not phonating, the nasopharynx is open and the resulting clear area is readily observed on the x-ray film as a translucent passage, averaging approximately 1 cm in its anteroposterior diameter. During phonation, as also during swallowing, the soft palate contracts and elevates, tending to encroach upon the nasopharynx and to obstruct communication between the oropharynx and nasopharynx.

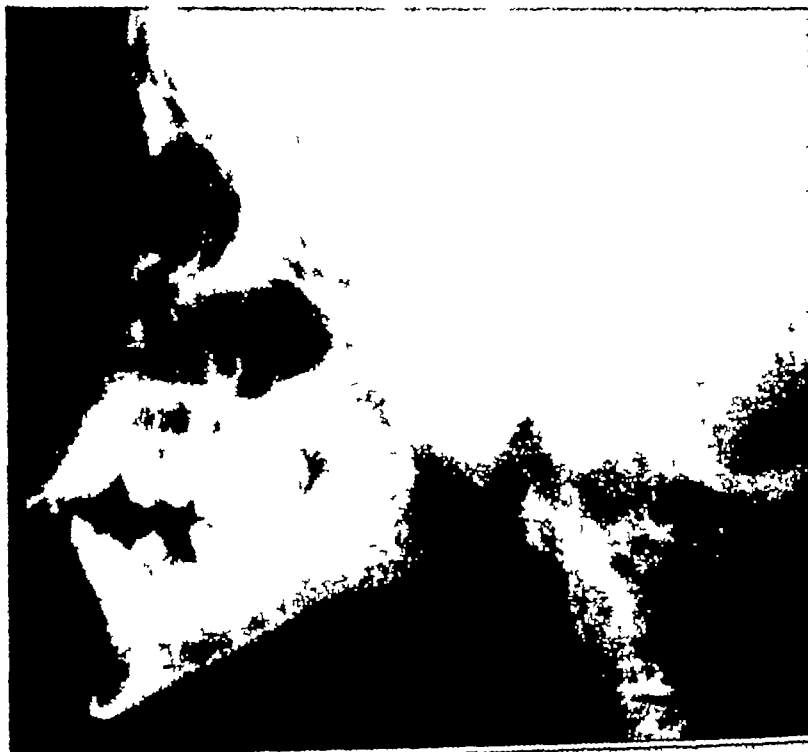
We have noted that films taken on children during crying spells show a narrowing of the nasopharyngeal breathing space due to elevation and a tendency of the uvula to straighten out in a posterior direction. Changes in position seem to have no influence on the position of the uvula and soft palate. Any interference with this function is interpreted as due to disturbances in innervation or lesions involving the soft palate.

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Figs 4 and 5 Apparent complete occlusion of posterior nasopharynx due to choanal atresia and adenoid hyperplasia. Figure 5 (below) made after instillation of 1 c.c. of lipiodol through the nares shows that atresia is not complete.





Figs 2 and 3 Preoperative and postoperative adenoid demonstration Note increase of breathing space

# EDITORIAL

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## Radiation Treatment of Benign and Inflammatory Conditions

The radiation treatment of benign and inflammatory conditions occupies an important place in modern therapeutics. The number of lesions found to respond well to radiation therapy has gradually increased over a period of years until at present nearly half of the cases seen in the radiotherapy department are treated for benign or inflammatory conditions. This excludes the use of radiation in dermatology, where its efficacy has been well demonstrated and it is widely employed.

The list of non-malignant lesions successfully treated is a long one, too long, in fact, to be presented in an editorial. If, however, we exclude the group in which there is only a small percentage of good results, along with those conditions about which there is lack of agreement as to the value of the treatment, we are still left with an impressive number of lesions which respond satisfactorily, and with which we should all be familiar.

Radiation treatment for non-malignant conditions is well tolerated and gives a fair percentage of good results in such conditions. That we are able to treat these lesions successfully, without deleterious effects from the treatment, either immediate or late, is the result of the investigations and careful observations of many of the earlier roentgenologists. That there are some patients now living who have skin changes as a result of improper irradiation for non-malignant conditions is no credit to the profession or specialty. Referring physicians may feel assured that skin damage is not necessary in the treatment of benign or inflammatory lesions. We have learned that most of the conditions listed, with the exception of the

### RADIATION TREATMENT OF NON-MALIGNANT CONDITIONS

#### Inflammatory

- 1 Tuberculous lymphadenitis
- 2 Acute lymphadenitis
- 3 Nasopharyngeal lymphoid hypertrophy
- 4 Parotitis
  - (a) acute postoperative
  - (b) chronic suppurative
- 5 Enlarged mediastinal lymph nodes following various infections, especially whooping cough
- 6 Herpes
  - (a) zoster
  - (b) simplex
- 7 Plantar warts

#### Benign Tumors

- 1 Angiomas
- 2 Cystic hygromas
- 3 Giant-cell tumors of bone
- 4 Fibroid uteri
- 5 Pituitary adenomas
  - (a) chromophil
  - (b) chromophobe
  - (c) basophil
- 6 Xanthomatosis

#### Other Conditions

- 1 Arthritis (Marie-Strümpell)
- 2 Bursitis
- 3 Cystic synovitis
- 4 Metrorrhagia (non-specific)
- 5 Keloids

pituitary adenomas and the giant-cell tumors, require only small fractionated doses of x-rays or radium, so small in fact that they may be frequently repeated if necessary.

For adenitis, such as that of tuberculous origin, radiation has for many years, in many localities, been the treatment of choice. Williams was the first to report on its efficacy nearly fifty years ago, but it has not been a generally accepted form of treatment until the past ten years. A review of 238 cases of tuberculous adenitis treated by surgery before 1928 and an equally large series treated by x-rays between 1928 and 1938 in our clinic revealed that the disease healed more rapidly after irradiation, especially if draining sinuses

tion of sinuses or mastoids, and in suspected cases of sinobronchial disease. The majority of these patients are infants and children. We have found the simplest and best procedure is to have the patient lie flat on his back staring up at a small Mickey Mouse (decal) on the ceiling. The tube is turned at right angles to the sagittal plane of the head. The film is held parallel to the sagittal plane of the head by resting it on end touching the patient's shoulder but not the head. The following factors are used: 50 kv, 1/4 sec, 50 mm, 25 ma.

The translucent shadow comprising the pharynx is in the form of a slightly bent rectangle. Its anterosuperior portion is bisected by the shadow of the soft palate and uvula, with the posterior nasopharynx above and the oropharynx below. The posterosuperior aspect of the pharynx is usually visualized as a straight or slightly convex soft-tissue shadow closely hugging the sloping contour of the base of the skull and continuous with the precervical tissues. The lymphoid tissue, if present, may project into the epipharynx as much as 6 or 7 mm. The base of the translucent pharynx is bisected by a soft-tissue shadow projecting upward and slightly forward. This is the epiglottis.

Not infrequently the tonsils can be visualized as an oral soft-tissue shadow superimposed on the pharyngeal space between the uvula and the epiglottis, just behind the base of the tongue.

On the basis of numerous measurements of lateral views of adenoid shadows in infants and children, any soft-tissue mass projecting 6 or 7 mm from the sloping roof of the pharynx can be considered as pathological. In nearly all cases it represents hyperplasia of the adenoids. We have made the following classification: (1) minimal hyperplasia of the adenoids, 7-9 mm in thickness, with slight encroachment (or none at all) on the postero-nasopharyngeal breathing space, (2) moderate hyperplasia, 1-1.5 cm, with moderate encroachment on the postero-nasopharynx, (3) marked hyperplasia, over

1.5 cm, with practically complete occlusion of the postero-nasopharynx.

Other lesions producing similar shadows should be thought of. When there is complete obliteration of the nasopharynx, one must consider the possibility of congenital choanal atresia. In such cases a few drops of lipiodol injected into the nares with the head supine, and a sufficient interval to allow the oil to flow back, will tell whether or not atresia is complete.

Infections, such as retropharyngeal abscess, must be differentiated by the position of the swelling and history.

Tumors include fibromas, carcinomas, Rathke's pouch tumors, and chordomas. Destruction or erosion of bone should be a differentiating factor in such cases. Rarely are protruding soft tissues associated with metastatic lesions of the upper cervical vertebrae.

#### SUMMARY

A single lateral roentgenogram of the pharyngeal area gives much anatomical and pathological information. It is especially advantageous in the differential diagnosis of soft-tissue masses of the epipharynx, and for routine employment in determining the presence or absence of enlarged adenoids. Advantages of x-ray over clinical examination of adenoids are as follows: (1) Avoidance of psychic trauma to children makes the examination a simple one. (2) The degree of breathing space encroachment can be accurately determined pre- and postoperatively.

Traverse City, Mich.

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# EDITORIAL

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The list of non-malignant lesions successfully treated is a long one, too long, in fact, to be presented in an editorial. If, however, we exclude the group in which there is only a small percentage of good results, along with those conditions about which there is lack of agreement as to the value of the treatment, we are still left with an impressive number of lesions which respond satisfactorily, and with which we should all be familiar.

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were present. Nodes which were firm at the beginning of radiation treatment decreased or disappeared and we were able to obviate a large, unsightly surgical scar, which was replaced by a small biopsy incision. The follow-up shows, also, that recurrences are no more likely following radiation treatment than following surgery or prolonged bed rest. Acute lymphadenitis, especially in children, is usually readily controlled by one or two small applications of x-rays.

Reports by Fricke and Brown, of the Mayo Clinic, by Fowler, of the U S Medical Corps, and by Fisher, of Birmingham, Alabama, show conclusively that nasopharyngeal lymphoid hypertrophy is well controlled by x-ray or radium treatment, preferably radium. To quote Fricke and Brown, who reported on 76 cases in which radium was used, definite improvement was obtained in 45, temporary improvement in 13, and no improvement in 18. Sixty-one of their patients complained chiefly of deafness and tinnitus, in 15, the chief complaints were colds and frequent sore throats. Hypertrophied lymphoid tissue was present in each case and, after thorough medical studies and audiometer examination, treatment was instituted. Of the patients treated primarily for deafness, 33 obtained definite and apparently permanent improvement, 11 were temporarily benefited, and 17 showed no change. Of the patients with colds and sore throats, 12 were definitely and permanently improved, 2 temporarily improved, and 1 not improved.

In chronic suppurative parotitis small doses of x-rays are effective. The glands gradually decrease in size and the supuration disappears. We prefer to have sialograms of the duct and gland, as well as bacteriologic examination of the secretions, before treatment is instituted, in order that the degree of change in the duct and ductules be shown and that we may be certain that there is no stricture of any portion of the duct.

The radiation treatment of acute post-operative parotitis is well known to be

efficacious and at the present time is being used in conjunction with other therapeutic agents, which probably will supplant it in the near future, namely, penicillin and the sulfonamides.

There are probably as many treatments for arthritis as there are physicians who treat this disease, not to mention the laymen who have their own "pet" cures. Unfortunately, few types of treatment seem to stand the test of time, and the results are difficult to evaluate. Scott of London, some years ago, reported on the success of radiation treatment in Marie-Strümpell arthritis. Following his report, many others began using this form of therapy, and all observers agree on the analgesia obtained, which in many cases is permanent. All are in agreement, also—Scott, Hare, Oppenheimer, Friedman, Kuhns, and Morrison—that results are better in the early stages of the disease, but sufficient improvement may be obtained even in late cases to warrant the treatment. In the early cases, in which the disease is limited to the sacroiliac articulations, one may expect good results in 60 to 80 per cent, that is, loss of pain and improvement in motion. In the moderately advanced cases, good results are obtained in 30 to 60 per cent, and in the advanced cases in 15 to 30 per cent.

It is indeed gratifying that patients with Marie-Strümpell arthritis are relieved. Many of our cases have been followed since 1938, and most of those who were originally helped have maintained their improvement, though with occasional recurrence of pain and with some progression of symptoms. In most cases roentgenograms have continued to show progression of the disease, which confirms our opinion that the treatment should be used as an analgesic, not as a cure. If the pain is stopped, however, few if any skeletal deformities occur later on in life, which more than makes this type of treatment desirable.

Radiation treatment for other types of arthritis is being widely used. We have obtained temporary relief in some cases,

but in most instances our results have been discouraging

In recent years, more and more cases of bursitis and peritendinitis have been referred to the radiology department for treatment. The strikingly good results which have been obtained by small fractionated doses of x-rays have surprised and pleased us all, especially in cases of acute bursitis or tendinitis of the shoulder joint, which is most frequently involved. Relief may be obtained with one or two treatments, but occasionally it is necessary to repeat the treatment at weekly intervals for five or six weeks. In approximately one-half the cases there is calcification in the tendons, indicating previous attacks of this condition or chronicity, but in 70 per cent of the cases relief may be obtained whether or not there is visible calcification. The calcification may remain visible although the patient becomes asymptomatic. In some cases in which an adhesive bursitis is found clinically, we have noted a complete return of motion following radio-

therapy, indicating the degree of muscle spasm present at the time of examination prior to treatment. Of 10 patients who were treated by x-rays following manipulation under anesthesia without relief, 7 were cured. The results were equally good whatever the location of the disease.

That similar good effects may be and are being obtained in the other conditions listed is an incentive to the radiologist to carry on further with lesions which are not amenable to other forms of treatment, and to try to improve his results in the group already known to be benefited by radiation.

As clinicians generally become cognizant of our ability to treat patients with inflammatory and benign lesions, even though it is in conjunction with other forms of therapy, we shall have the opportunity of treating more and more of these conditions, and results may be further improved.

HUGH F HARF, M D  
*Lahey Clinic, Boston*

## The Annual Meeting Radiological Society of North America

The Program of the Thirty-second Annual Meeting of the Radiological Society of North America, to be held in Chicago, Dec 1-Dec 6, is in course of preparation. Contributions are invited, and those desiring to participate are urged to communicate at once with the Program Committee, of which Dr Lowell Goin (1930 Wilshire Blvd, Los Angeles 5, Calif) is chairman.

## IN MEMORIAM

" those immortal dead who live again  
In minds made better by their presence "

### Rollin Howard Stevens, M D

1868-1946

American radiology lost one of its pioneers and the Radiological Society of North America one of its most loyal members in the death, on May 17, 1946, of Dr. Rollin H. Stevens, at the age of seventy-eight, of an acute leukemia.

Rollin H. Stevens was born in Blenheim, Ontario, in 1868. He received his early education in Canada and later entered the Homeopathic Medical School of the University of Michigan, from which he received his degree in medicine in 1889. Immediately following his graduation he became one of the first interns at Grace Hospital, Detroit, and his association with that institution continued throughout his life.

During his early professional years, Dr. Stevens was particularly interested in dermatology and, in order to acquaint himself at first hand with the Finsen light treatment, then coming into widespread use, he visited Europe in 1902, spent a number of months at the Finsen Institute in Copenhagen, and attended dermatologic clinics in Germany, Austria, and Great Britain. The interest in light therapy thus stimulated extended to the therapeutic use of other radiations, and upon his return to Detroit, he decided to devote himself to the practice of radiology and dermatology. In 1904, he was appointed Dermatologist and Roentgenologist to Grace Hospital, which position he occupied until the time of his death.

In 1903, Dr. Stevens obtained his first supply of radium from the Curie Institute in Paris and two years later made his first report on its therapeutic application. He was thus one of the early American pioneers in radium and roentgen therapy. He was constantly on the alert for new advances in equipment and technique and was deeply concerned with problems of standardization and protection. His achievements in his specialty were recognized on his seventieth birthday by the publication (January 1938) of the Rollin Howard Stevens Birthday issue of *RADIOLOGY*, containing "an anniversary chronicle of his useful life" and a bibliography of his scientific papers to that date.

The subject of cancer was one of paramount interest to Dr. Stevens, both in its biologic and therapeutic aspects. He realized fully the magnitude of the problem and the necessity for co-opera-

tive effort on the part of scientists from many fields for its ultimate solution. In his later years his consuming passion was the establishment of facilities for cancer research, and through his enthusiasm and persistent efforts there came into being the Detroit Institute of Cancer Research, of which he was the first president. His devotion to this project led him to give largely of his time and thought, even during the trying days of his last illness, to assure its continuation adequately housed and under competent direction.

Dr. Stevens was a member of the American Roentgen Ray Society, the American Radium Society, of which he was president in 1933-34, and the Radiological Society of North America, which he served as president in 1924. He was a founder of the American College of Radiology, was several times a chancellor of that organization and its president in 1930-31. He was one of the founders, also, of the American Board of Radiology and for a number of years was one of its examiners. He was active in the organization of the Detroit X-Ray and Radium Society, serving as its president in 1926. He was president of the Detroit Dermatological Society in 1927.

The problems of medicine did not, however, occupy Dr. Stevens to the exclusion of other interests. His achievements in mycology, his pride in his large collection of shells, and his devotion to his gardens were known to all his intimates. He spent much time and energy, also, in civic affairs. The Social Hygiene Society of Detroit was organized through his efforts, and he was a founder and active promoter of the Boys' Republic at Farmington, Mich.

Those who were privileged to know and work with Dr. Stevens have had their lives enriched by association with a real scientist, a beloved physician, and a true gentleman. His unbounded enthusiasm and catholicity of interests kept him ever youthful in mind and spirit, an inspiration both to his younger colleagues and his contemporaries.

Dr. Stevens is survived by his wife, Dr. Mary Thompson Stevens, a daughter, Mrs. Milton Davis, and two granddaughters.

HOWARD P. DOUB, M D



ROLLIN HOWARD STEVENS, M D  
1868-1946



# Albert Soiland, M D

1873-1946

American radiologists grieve for the loss of one of their pioneers. Dr. Albert Soiland of Los Angeles, California, died in Stavanger, Norway, on May 14. He had sailed on April 7 from the Pacific coast, through the Panama Canal, and across the Atlantic, to enjoy a visit at his home in Norway. A few days after his arrival, he suffered a sudden heart attack, which proved fatal. Funeral services were held for him in Stavanger on May 18. His ashes will be returned to America.

Albert Soiland was born in Norway, May 5, 1873, the son of Edward and Axelme Christine (Halversen) Soiland. The first ten years of his life he spent in his native land and the following sixty-three years in America. He married Dagfinn Berner Svendsen of Stavanger, Norway, in 1902.

The list of Dr. Soiland's activities and accomplishments denotes the fullness of his life in America. He received his medical education at the University of Southern California, from which he was graduated in 1900. His interest in radiology began during his college days, and as early as April 1902 he published "A Case of Carcinoma of the Breast Treated by X-Rays." In the earlier years of his practice he contributed to all phases of radiology, later he devoted himself to therapeutic irradiation. With his associates he established the Albert Soiland Radiological Clinic in 1910. Later, as senior member of Soiland, Costolow, and Meland, specializing in the study and treatment of cancer and allied diseases, he established the Los Angeles Tumor Institute.

For some years Dr. Soiland had been formulating plans for creating a foundation to promote the study and prevention of cancer, and shortly before his death he established the Albert Soiland Cancer Foundation, deeding to it the California Medical Building, which he owned, and a sum of approximately one million dollars. In addition to cancer research, the foundation will provide fellowships in the study and control of cancer.

Dr. Soiland was a diplomate of medical radiology and electrology, University of Cambridge, England, a diplomate of the American Board of Radiology, founder and former professor in the Department of Radiology, College of Medicine and Surgery, University of Southern California, founder-member of the School of Medicine, University of Southern California, founder, past president, fellow (honorary), and medalist of the American College of Radiology, past president of the American Radium So-

ciety, past president of the Western Division of the American Roentgen Ray Society, a founder and past chairman of the Section on Radiology of the American Medical Association, the Section on Radiation of the California Medical Association, and the Section on Radiology of the Los Angeles County Medical Association. He was a member of the Radiological Society of North America and one of its early presidents (1918). In recognition of his services to the Society and his numerous contributions to RADIOLOGY, the May 1933 issue of that journal was dedicated to him, honoring his sixtieth birthday. The list of his contributions to the literature appearing there includes some 150 titles.

To recount, with even a brief reference, Dr. Soiland's outstanding activities and achievements would require space not available here. His interest in medical organization work led him to attend many society meetings in this country and abroad, and his name was frequently found on scientific programs. His attendance at national and international gatherings as a representative of the U. S. Navy began in 1915 (Lieut. jg., M. R. C., U. S. N.) and continued into World War II (Captain, M. C. V. (S) U. S. N. R. ret. act), constituting a duty which he performed with dignity and good fellowship.

Pausing to consider the great number of occasions in which he participated over so many years, in so many places, all requiring special preparation, in addition to his extensive daily responsibilities in medical radiology, we stand aghast. It was obvious to those of us who knew him more intimately how fully his wakeful moments were utilized, his mind was always active in a constructive way.

Dr. Soiland was courageous, enthusiastic, and tireless in all of the activities with which he became identified. It is gratifying that he lived to see the success of so many of his undertakings both in and out of the realm of medicine.

In the development of radiology in North America he played a significant role. He was a leader in elevating it to a specialty of the first rank, eliminating the imposters, and linking it solidly with medical science within the medical profession. His intimate companions and his associates in the Institute he founded had an affection for him which was nothing short of love. He leaves indelible memories of loyalty and friendliness with hosts of physicians in all divisions of medicine, here and throughout the world.

BENJAMIN H. ORNDORFF, M. D.



ALBERT SOILAND, M D  
1873-1946

## ANNOUNCEMENTS

### CALIFORNIA MEDICAL ASSOCIATION SECTION ON RADIOLOGY

The Radiological Section of the California Medical Association has selected the following officers for the ensuing year: Gordon G. King, M.D., of San Francisco, Chairman; D. R. MacColl, M.D., of Los Angeles, Secretary.

### FLORIDA RADIOLOGICAL SOCIETY

The recently elected officers of the Florida Radiological Society are: Charles M. Gray, M.D., of Tampa, President; James F. Pitman, M.D., of Lake City, Vice President; Mavey Dell, Jr., M.D., of Gainesville, Secretary.

### RADIOLOGICAL SOCIETY OF NEW JERSEY

At the annual meeting of the Radiological Society of New Jersey, the following were elected to office: Dr. John Olpp, Englewood, President; Dr. H. R. Brindle, Asbury Park, Vice-President; Dr. W. H. Seward, Orange, Secretary; Dr. R. Pomeranz, Newark, Treasurer; Dr. C. B. Henle, Newark, Councilor to the Radiological Society of New Jersey; Dr. H. J. Perlberg, Jersey City, Councilor to the American College of Radiology.

### PENNSYLVANIA RADIOLOGICAL SOCIETY

The Thirty-first Annual Meeting of the Pennsylvania Radiological Society was held in Reading, Penna., on May 17 and 18. The program included papers by Leslie H. Osmond, M.D., of Pittsburgh; George W. Chamberlin, M.D., of Reading; Edith H. Qumby, Sc.D., of New York City; E. C. Baker, M.D., of Youngstown, Ohio; Zoe A. Johnston, M.D., of Pittsburgh; J. L. Weatherwax, M.A., of Philadelphia; Burrill B. Crohn, M.D., of New York City; Samuel G. Henderson, M.D., and Melvin Meyers, M.D., of Pittsburgh; Ralph Bromer, M.D., of Bryn Mawr; Robert P. Barden, M.D., of Philadelphia; Harold W. Jacob, M.D., of Pittsburgh; and Louis A. Milkman, M.D., of Scranton.

The *Pennsylvania Journal of Radiology* issued on this occasion was dedicated to Dr. Sydney James Hawley, "gentleman, scholar, author, scientist, poet, and musician." Dr. Hawley has recently severed his connection with the Geisinger Memorial Hospital, Danville, Penna., to return to the city of his birth, Seattle, Wash.

### UTAH STATE RADIOLOGICAL SOCIETY

At a dinner meeting on May 15, radiologists of Utah organized the Utah State Radiological Society. Dr. James P. Kerby of Salt Lake City was elected

President and Dr. M. Lowry Allen, also of Salt Lake City, Secretary-Treasurer. Meetings are to be held on the third Wednesday in the following months: September, November, January, March, and May.

### MID-SUMMER RADIOLOGICAL CONFERENCE

As announced in the May issue of *RADIOLOGY*, the Rocky Mountain Radiological Society is resuming its Mid-Summer Radiological Conference, to be held in Denver, Colo., Aug. 8-10, 1946. The program committee is arranging an excellent program, with Dr. John Camp, Dr. William E. Costolow, Dr. Ross Golden, and Dr. Dabney Kerr as guest speakers. Radiologists and other physicians are urged to attend.

### RADIOLOGISTS HONORED BY STATE MEDICAL SOCIETIES

Radiologists in general, and members of the Radiological Society of North America in particular, will be glad to hear of honors recently accorded to two of their number. Dr. Harold A. Spilman of Ottumwa, Iowa, a member of the Society since 1924, was elected president of the Iowa State Medical Society at its annual convention, April 19. That radiologists have the respect and esteem of their professional colleagues is evidenced by the fact that Dr. Spilman is the seventh member of the Iowa X-Ray Club, the fifth member of the Radiological Society, the fourth Fellow of the American College of Radiology, and the third Diplomate of the American Board of Radiology to receive the highest honor that Iowa physicians can award a colleague.

A similar honor has been accorded Dr. Edgar P. McNamee, of Cleveland, Ohio, who at the recent meeting of the Ohio State Medical Society assumed the presidency of that organization.

### RADIO ISOTOPES FROM THE MANHATTAN PROJECT

A detailed announcement on the availability and procurement of pile-produced radio isotopes from the Manhattan Project appears in the June 14 issue of *Science*.

Tables are included giving pertinent data on the characteristics and the quantities which may be made available of around 100 isotopes and isotopic mixtures. For practical reasons isotopes with a half-life less than twelve hours are not considered for distribution. Most of the isotopes are produced by fission or (n) processes. Only four isotopes are produced by the (n, p) process with sufficient yield

for distribution. Other processes are either not sufficiently productive or do not occur.

The article emphasizes that (1) present piles were not designed for tracer and therapeutic isotope production, (2) waste plutonium process solutions are not a feasible source for separated fission isotopes, (3) routine production methods and facilities are not yet developed for most isotopes, (4) isotopes which can now be made available are only experimental lots resulting from research and development proceedings, (5) technical problems involved in the irradiation and processing of essential materials have been and will continue to be responsible for the delay in making certain isotopes available by routine production.

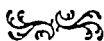
Allocation and distribution will be effected on the basis of the general policies, as well as on recommendations regarding specific applications, made by well qualified advisory groups nominated for Manhattan District appointment by the National Academy of Sciences. Charges will be made for materials and services on the basis of "out-of-pocket" operational expenses to the Government necessitated by

the non-project production and service program. Costs for construction or rental of major plant facilities and expenses of research and development on isotope production will be assumed by the Project.

All correspondence concerning radio isotope procurement should be addressed to the Isotopes Branch, Research Division, Manhattan District, P O Box E, Oak Ridge, Tennessee. Reference to the original article for pertinent details is recommended before the institution of inquiries or requests.

#### AMERICAN CONGRESS OF PHYSICAL MEDICINE

The American Congress of Physical Medicine will hold its Twenty-fourth Annual Scientific and Clinical Session September 4-7, inclusive, at the Hotel Pennsylvania in New York. In addition to the scientific sessions, the annual instruction courses will be held Sept 4, 5, and 6. Further information may be obtained from the American Congress of Physical Medicine, 30 North Michigan Ave., Chicago 2, Ill.



# RADIOLOGICAL SOCIETIES OF NORTH AMERICA

*Editor's Note*—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich

## UNITED STATES

*Radiological Society of North America*—Secretary, D. S. Childs, M.D., 607 Medical Arts Bldg., Syracuse 2, N.Y.

*American Roentgen Ray Society*—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa

*American College of Radiology*—Secretary, Mac F. Cahal, 20 N. Wacker Dr., Chicago 6, Ill.

*Section on Radiology, American Medical Association*—Secretary, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio

## ARKANSAS

*Arkansas Radiological Society*—Secretary, Fred Hames, M.D., Pine Bluff. Meets every three months and annually at meeting of State Medical Society

## CALIFORNIA

*California Medical Association, Section on Radiology*—Secretary, D. R. MacColl, M.D., 2007 Wilshire Blvd., Los Angeles 5

*Los Angeles County Medical Association, Radiological Section*—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building

*Pacific Roentgen Society*—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with California Medical Association

*San Diego Roentgen Society*—Secretary, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego, Calif. Meets first Wednesday of each month

*San Francisco Radiological Society*—Secretary, Joseph Levitin, M.D., 516 Sutter St., San Francisco 2. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year in Lane Hall, Stanford University Hospital, and second six months in Toland Hall, University of California Hospital

## COLORADO

*Denver Radiological Club*—Secretary, A. Page Jackson, Jr., M.D., 304 Republic Bldg., Denver 2. Meetings third Friday of each month, Denver Athletic Club

## CONNECTICUT

*Connecticut State Medical Society, Section on Radiology*—Secretary, Max Chiman, M.D., 242 Trumbull St., Hartford 3. Meetings bimonthly, second Thursday

## FLORIDA

*Florida Radiological Society*—Secretary-Treasurer, Maxey Dell, Jr., M.D., 333 West Main St., S., Gainesville.

## GEORGIA

*Georgia Radiological Society*—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N.E., Atlanta 3. Meets in November and at the annual meeting of State Medical Association

## ILLINOIS

*Chicago Roentgen Society*—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April

*Illinois Radiological Society*—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

*Illinois State Medical Society, Section on Radiology*—Secretary, Frank S. Hussey, M.D., 250 East Superior St., Chicago 11

## INDIANA

*The Indiana Roentgen Society*—Secretary-Treasurer, J. A. Campbell, M.D., Indiana University Hospitals, Indianapolis 7. Annual meeting in May

## IOWA

*The Iowa X-ray Club*—Secretary, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of Iowa State Medical Society

## KENTUCKY

*Kentucky Radiological Society*—Secretary-Treasurer, Sydney E. Johnson, M.D., 101 W. Chestnut St., Louisville

## LOUISIANA

*Louisiana Radiological Society*—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society

*Orleans Parish Radiological Society*—Secretary, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month

*Shreveport Radiological Club*—Secretary, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday, 7:30 P.M.

## MARYLAND

*Baltimore City Medical Society, Radiological Section*—Secretary, Charles N. Davidson, M.D., 101 West Read St., Baltimore 1

## MICHIGAN

*Detroit X-ray and Radium Society*—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May at Wayne County Medical Society club rooms

## MINNESOTA

*Minnesota Radiological Society*—Secretary, A. T. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 28. Meetings quarterly

## MISSOURI

*Radiological Society of Greater Kansas City*—Secretary, John W. Walker, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Friday of each month

*St. Louis Society of Radiologists*—Secretary, Edwin C. Ernst, M.D., 100 Beaumont Medical Bldg. Meets on fourth Wednesday of each month, October to May

## NEBRASKA

*Nebraska Radiological Society*—Secretary-Treasurer, Donald H. Breit, M.D., University of Nebraska Hospital, Omaha 5. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln

## NEW ENGLAND

*New England Roentgen Ray Society*—Secretary-Treasurer, George Levene, M.D., Massachusetts Memorial

Hospitals, Boston, Mass Meets monthly on third Friday at Boston Medical Library

#### NEW HAMPSHIRE

*New Hampshire Roentgen Society*—Secretary-Treasurer, Richard C Batt, M D, St Louis Hospital, Berlin

#### NEW JERSEY

*Radiological Society of New Jersey*—Secretary, W H Seward, M D, Orange Memorial Hospital, Orange Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called

#### NEW YORK

*Associated Radiologists of New York, Inc*—Secretary, William J Francis, M D, East Rockaway, L I

*Brooklyn Roentgen Ray Society*—Secretary-Treasurer, Abraham H Levy, M D, 1354 Carroll St, Bklyn 13 Meets fourth Tuesday of every month, October to April

*Buffalo Radiological Society*—Secretary-Treasurer, Mario C Gian, M D, 610 Niagara St., Buffalo 1 Meetings second Monday evening each month, October to May, inclusive.

*Central New York Roentgen Society*—Secretary-Treasurer, Carlton F Potter, M D, 425 Waverly Ave, Syracuse 10 Meetings in January, May, and October

*Long Island Radiological Society*—Secretary, Marcus Wiener, M D, 1430 48th St, Brooklyn 19 Meetings fourth Thursday evening each month at Kings County Medical Bldg

*New York Roentgen Society*—Secretary, Wm Snow, M D, 941 Park Ave, New York 28

*Rochester Roentgen-Ray Society*—Secretary, Murray P George, M D, 260 Crittenden Blvd, Rochester 7 Meets at Strong Memorial Hospital, third Monday, September through May

#### NORTH CAROLINA

*Radiological Society of North Carolina*—Secretary-Treasurer, Major I Fleming, M D, 404 Falls Road, Rocky Mount Meets in May and October

#### NORTH DAKOTA

*North Dakota Radiological Society*—Secretary, Charles Heilman, M D, 1338 Second St, N, Fargo

#### OHIO

*Ohio Radiological Society*—Secretary, Henry Snow, M D, 1061 Reibold Bldg, Dayton 2 Next meeting at annual meeting of the Ohio State Medical Association

*Cleveland Radiological Society*—Secretary-Treasurer, Carroll C Dundon, M D, 11311 Shaker Blvd, Cleveland 4 Meetings at 6 30 P M on fourth Monday of each month from October to April, inclusive.

*Radiological Society of the Academy of Medicine* (Cincinnati Roentgenologists)—Secretary-Treasurer, Samuel Brown, M D, 707 Race St, Cincinnati 2 Meetings held third Tuesday of each month

#### PENNSYLVANIA

*Pennsylvania Radiological Society*—Secretary-Treasurer, L D Wurster, M D, 416 Pine St, Williamsport 8

*Philadelphia Roentgen Ray Society*—Secretary, Calvin L Stewart, M D, Jefferson Hospital, Philadelphia 7 Meets first Thursday of each month at 8 00 P M, from October to May in Thomson Hall, 21 S 22d St.

*Pittsburgh Roentgen Society*—Secretary-Treasurer, Lester M J Freedman M D 4800 Friendship Ave,

Pittsburgh 24 Meets second Wednesday of each month at 6 30 P M, October to May, inclusive

#### ROCKY MOUNTAIN STATES

*Rocky Mountain Radiological Society*—Secretary, A M Popma, M D, 220 N First St, Boise, Idaho

#### SOUTH CAROLINA

*South Carolina X-ray Society*—Secretary-Treasurer, Robert B Taft, M D, 103 Rutledge Ave, Charleston 16

#### TENNESSEE

*Memphis Roentgen Club*—Chairmanship rotates monthly in alphabetical order Meetings second Tuesday of each month at University Center

*Tennessee Radiological Society*—Secretary-Treasurer, J Marsh Frère, M D, 707 Walnut St, Chattanooga Meets annually with State Medical Society in April

#### TEXAS

*Dallas-Fort Worth Roentgen Study Club*—Secretary, X R Hyde, M D, Medical Arts Bldg, Fort Worth 2 Meetings on third Monday of each month, in Dallas in the odd months and in Fort Worth in the even months

*Texas Radiological Society*—Secretary-Treasurer, R P O'Bannon, M D, 650 Fifth Ave., Fort Worth 4

#### UTAH

*Utah State Radiological Society*—Secretary-Treasurer, M Lowry Allen, M D, Judge Bldg, Salt Lake City 1 Meets third Wednesday, January, March, May, September, November

#### VIRGINIA

*Virginia Radiological Society*—Secretary, E Latan Flanagan, M D, 215 Medical Arts Bldg, Richmond 19

#### WASHINGTON

*Washington State Radiological Society*—Secretary-Treasurer, Thomas Carlile, M D, 1115 Terry Ave, Seattle Meetings fourth Monday of each month, October through May, at College Club, Seattle

#### WISCONSIN

*Milwaukee Roentgen Ray Society*—Secretary-Treasurer, C A H Fortier, M D, 231 W Wisconsin Ave., Milwaukee 3 Meets monthly on second Monday at the University Club

*Radiological Section of the Wisconsin State Medical Society*—Secretary, S R Beatty, M D, 185 Hazel St, Oshkosh Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society in September

*University of Wisconsin Radiological Conference*—Meets first and third Thursdays 4 to 5 P M, September to May, inclusive, Room 301, Service Memorial Institute, 426 N Charter St., Madison 6

#### CANADA

*Canadian Association of Radiologists*—Honorary Secretary-Treasurer, J W McKay, M D, 1620 Cedar Ave, Montreal

*La Société Canadienne-Française d'Electrologie et de Radiologie Médicales*—General Secretary, Origène Dufresne, M D, Institut du Radium, Montreal Meets on third Saturday of each month

#### CUBA

*Sociedad de Radiología y Fisioterapia de Cuba*—Offices in Hospital Mercedes, Havana Meets monthly

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### Gynecology and Obstetrics

- SCHETZ, RAYMOND J, GOOD, C ALLEN, AND HUNT, ARTHUR B Roentgenologic Localization of the Placenta (Placentography) 96

While cavities can be obliterated by thoracoplasty, the bronchiectasis remains. Thus may or may not give rise to a persistently positive sputum, but why some patients with extensive residual bronchiectasis have tubercle bacilli in the sputum and others do not is unknown. The only type of case that seems satisfactory for thoracoplasty is the one with a relatively early apical cavity. Here there may be no demonstrable bronchiectasis. In all others the success or failure of the procedure is completely unpredictable. In the first part of the paper a group of successful cases is reported. It is shown by bronchography that, even in these, persistent and often widespread bronchiectasis may be present and that a large amount of previously healthy lung must frequently be sacrificed in order to arrest the disease.

L W PAUL, M D

**The Chest X-Ray in War Time Industrial Examinations.** William L Bosnet. J M Soc New Jersey 42: 253-261, August 1945

The importance of roentgen studies of the chest in pre-employment examinations for industrial groups is again emphasized. The author sets forth the advantages of the photoroentgen method and gives the technical factors and processing procedure in some detail. Stereoscopic 4 by 5 inch films made with a rotating anode tube and a grid were found to give a high degree of diagnostic accuracy.

Patients are classified as follows:

**Class A** Employable and not requiring x-ray recheck. This group includes cases of arrested minimal tuberculosis, thoracic deformities, rib deformities, cervical ribs, spinal deformities, eversion of the diaphragm, foreign bodies, dextrocardia, enlarged heart, aneurysm, azygos lobe, emphysema, and calcified pleura.

**Class B** Employable pending x-ray and/or clinical recheck. Under this head are cases with apical capping with underlying parenchymal lesion, minimal exudative tuberculous lesions, minimal to moderate fibro-productive tuberculous lesions, fibrotic tuberculous lesions, some pneumothoraces (if under care of family doctor), incompletely resolved virus pneumonia, hilar adenopathy, tumors, effusion, generalized fibrosis, bronchitis, pleurisy, thoracoplasty, and pneumoconiosis.

**Class C** Not employable. This group includes those with cavitation or other evidence of active tuberculosis, tuberculous effusion, pneumothoraces not in Class B, oleothoraces, and cases in Class B found unstable on additional examinations.

[This appears to the abstractor to be a very liberal classification of employable personnel, probably justified during wartime and with the special facilities available at the author's installation for using the services of the partially incapacitated.]

Approximately 20,000 chest radiographs were made by photoroentgen methods in less than a year. Over 95 per cent of all those receiving pre-employment examinations were immediately put in Class A. About 4 per cent were put in Class B, and 0.24 per cent in Class C. The corresponding figures in a survey, on a voluntary basis, of employed personnel were 90 per cent, 9 per cent, and 0.06 per cent.

Included in this article is an excellent review of the diagnostic features of the various stages and types of tuberculosis with an extensive differential diagnostic listing.

BERNARD S KALAYIAN, M D

**Ulcerative Tracheobronchitis Following Atypical Pneumonia. Report of Cases.** Earle B Kay. Arch Int Med 76: 93-101, August 1945

Twenty-nine of 150 patients examined bronchoscopically at an Army hospital during the first six months of 1944 were found to have ulcerative lesions of the tracheobronchial tree. In 6 patients the lesions were secondary to tuberculosis, in 4, to bronchiectasis, and in 3 they were associated with pulmonary abscesses. One patient had blastomycosis and one Boeck's sarcoid, in 5, the cause of the lesions could not be determined. In the other 9 cases, the ulcerative tracheobronchitis appeared to be secondary to previous attacks of atypical pneumonia, and it is with these cases that this paper is primarily concerned.

Ulcerative tracheobronchitis associated with atypical (viral) pneumonia may be indistinguishable bronchoscopically from similar superficial ulcerations due to Boeck's sarcoid, from the chronic infective granulomas, and from the bronchomycoses. Early or superficial ulcerative tuberculous tracheobronchitis most closely simulates the ulcerations following atypical pneumonia, although it tends to be even more chronic and resistant to therapy. Laboratory studies in these diseases, however, usually establish the diagnosis.

Four cases of tracheobronchitis secondary to atypical pneumonia are presented in detail. These are characteristic of the group as a whole and illustrate the various clinical, roentgenographic, and bronchoscopic aspects. Each of the patients had two to four previous episodes of atypical pneumonia, all followed by chronic productive bronchitis and general debility. Hemoptysis occurred in three patients. The first case illustrates migratory atypical pneumonia followed by bilateral ulcerative tracheobronchitis, with bronchographic evidence of cylindric bronchial dilatation. The second case is similar but emphasizes atelectasis. The third case was complicated by bronchostenosis and obstructive emphysema. In the fourth, there was ulcerative bronchitis with no roentgenographic evidence of pulmonary residua.

The treatment of ulcerative tracheobronchitis due to atypical pneumonia is discussed. Roentgenograms are reproduced.

**Measles-Pneumonia (with a Note on the Giant Cells of Measles).** George Milles. Am J Clin Path 15: 334-338, August 1945

Pneumonia occurs so commonly in measles and assumes such a characteristic form that it should be looked upon as an integral part of the disease rather than as a more or less accidental complication. The pulmonary lesion of measles results from extension of the lesion of the mucous membrane along the bronchial tree to the finer ramifications. The partial obstruction of the smaller passages by desquamated epithelium and mucus leads to conversion of the process from a catarrhal inflammation, characteristic of the larger air passages, to a purulent process. Extension into the peribroncholar tissues and into the neighboring alveoli results in a bronchopneumonia, which may be disseminated and discrete or may become confluent. In either instance the pneumonia is specific if one may interpret the presence of even a rare Alagna giant cell, with its bare agglomeration of eight or more nuclei, as specific for measles. The roentgenogram of the disseminated process is not unlike that obtained in military tuberculosis or, rarely, in atypical pneumonia.

## ROENTGEN DIAGNOSIS

### THE HEAD AND NECK

**Radiology of War Injuries Part V War Wounds of the Orbit and Eyeball** D B McGrogan and Eric Samuel *Brit. J. Radiol.* 18 284-290, September 1945

In half of a series of 800 orbital injuries sustained in battle, intra ocular foreign bodies were found to be present, 50 per cent of these were demonstrable radiographically.

In no field is greater accuracy required than in the study of injuries of the orbit. A preliminary examination should be made to determine whether or not a foreign body is present. This is usually done with a postero anterior and a lateral view. Non screen films have the advantage of affording greater detail, with less likelihood of extraneous shadows, but the greater exposure time increases the chances of motion, with consequent blurring of the foreign-body shadow. In general, films made with good clean screens are preferable. If a foreign body is present, it is advisable to make further films with the eye in various positions, looking up and looking down. The direction and degree of shift of the shadow of the foreign body will indicate in what portion of the eyeball it lies.

No entirely satisfactory method of localization has been worked out. With foreign bodies near the periphery, an accuracy of 0.5 mm is desirable. The limbus ring method and the equatorial ring method have the disadvantage of possible trauma to an already injured eye and they do not adequately take into consideration projection errors. McGrogan's spectacle method has the advantage that it may be used in patients confined to bed. It is, furthermore, mathematically accurate. The main disadvantage is that for the inexperienced it involves the technical difficulties incident to a high degree of accuracy. The 'false-eye' method accurately localizes the foreign body, but exact positioning is difficult and a good stereoscopic sense is necessary.

Injuries of the orbital region may be classified as (a) wounds affecting the globe, with and without radiological demonstration of foreign bodies, (b) wounds involving the bony orbit, including fractures due to gunshot wounds and closed fractures.

The bizarre fractures produced by high-velocity missiles in the long bones may be reproduced in the orbital walls. Any type of fracture may be found. Fractures involving the roof of the orbit are frequently associated with fractures of the base of the skull. Fractures of the medial wall generally involve the orbital plate of the ethmoid, while fractures of the lateral wall and the base are often associated with fractures of the facial bones. The importance of fractures of the floor of the orbit, from an ocular standpoint, lies in the possible displacement of the globe, with resulting diplopia.

SYDNEY J HAWLEY M D

**Symmetric Defects in the Lower Lids Associated with Abnormalities of the Zygomatic Processes of the Temporal Bones.** Irving H Leopold, J Francis Mahoney, and Mabel Lee Price. *Arch. Ophth.* 34 210-214, September 1945

Three cases of symmetric defects in the outer third of each lower lid, with roentgen evidence of absence of

the zygomatic processes of the temporal bones, occurring in a grandparent, mother, and daughter, are recorded. The ancestral history of these patients suggests that the defect was hereditary and that the trait is a dominant one. Roentgenograms and photographs are reproduced.

**Deafness with Undeveloped Mastoid and Normal Tympanic Membrane** Fordyce Johnson. *Arch. Otolaryng.* 42 174-177, September 1945

During the examination of Army personnel for hearing defects, a number of men were seen with deafness of varying degrees, of undetermined cause, with normal external ear, ear canal, and ear drum. Roentgenography in these cases showed underdeveloped or undeveloped mastoids on the affected side. It is believed that this condition is the result of an infectious process during the developmental period of the mastoid. Three cases are presented.

The author concludes that deafness dating from early childhood in the presence of a normal tympanic membrane should be checked by roentgenograms of the mastoid.

### THE CHEST

**Family Histories in Tuberculosis.** S E Simpson. *Am. Rev. Tuberc.* 52 231-247, September 1945

Examination of contacts offers an interesting and profitable method of discovering new cases of pulmonary tuberculosis. The results of such a study in five groups of families are presented. The first group consisted of a single family in which tuberculosis involved one person in each of three succeeding generations. In the second group, a family consisting of 28 members, the history of tuberculosis could be traced for eighteen years. The disease apparently remained limited to the family of which 14 members showed infection either by positive Mantoux reactions or active tuberculosis. In the third group there was involvement of two families unrelated except through contact of one individual in the first with a member of the second. In the fourth group the disease had spread beyond the confines of a family group by direct contact with others. The last group was the most complex of all, nine families being involved, five of them related by marriage and four only by contact with some of the first five. The report emphasizes the difficulties, not in getting the contacts to the clinic, but rather in persuading patients with newly discovered cases to accept sanatorium care.

L W PAUL M D

**Bronchography in Pulmonary Tuberculosis Thoracoplasty** B A Dornier, J Friedlander, and F J Wiles. *Am. Rev. Tuberc.* 52 145-154, 258-263, August and September 1945

As part of a series on bronchography in tuberculosis, the two-part article listed above deals with the uses and value of iodized-oil studies before and after thoracoplasty. In the authors' experience, the results of thoracoplasty are unpredictable. This is chiefly due to the fact that bronchial block and bronchiectasis are almost always present even in early stages of tuberculosis.

results achieved by adequate operations on the pulmonary abscess, as well as on the complicating empyema which is often present, provide an additional incentive to establish the diagnosis of shut-off putrid pulmonary abscess

**Interlobar Effusion Associated with Congestive Heart Failure** S Boharas and Leo H Crip *Ann Int Med* 23 426-431, September 1945

A case is recorded to illustrate the unusual finding of interlobar effusion in congestive heart failure unassociated with fluid in the pleural cavity. Only 14 such instances were found in a review of the literature. Necropsy in several of the reported cases showed that fluid collected in the interlobar space either because of local adhesions or an adhesive pleurisy which obliterated the entire pleural cavity with the exception of the small space between the lobes of the lung. The cause of the adhesions in one case was a healed tuberculous lesion, in the others it was unknown.

Interlobar effusion may be associated with any type of cardiac disease, the prerequisites being congestive heart failure and an antecedent adhesive pleurisy. Clinically, there are no significant signs or symptoms. Diagnosis, therefore, rests upon the characteristic roentgen shadow. The site of the effusion determines the location of the shadow, and its size and shape depend upon the amount of fluid present and the degree of compression of the adjacent lung. Interlobar effusion usually causes a dense, sharply demarcated, homogeneous shadow. It may be round, oval, spindle-, wedge-, or band-shaped. The margins are sharp unless there is thickening of the adjacent pleura or disease in the adjacent lung.

The roentgen shadow of interlobar effusion may simulate the appearance of interlobar empyema or of bronchogenic carcinoma, metastatic neoplasm, pulmonary infarction, pneumonia, gumma, or a localized caseating lesion situated in the region of the interlobar septum. The differential diagnosis will depend upon (1) the general clinical picture, (2) careful roentgen examination, and (3) response to therapy. A lateral view of the chest may be necessary in differentiating an intrapulmonary lesion from interlobar effusion. Interlobar effusion due to heart failure will diminish or disappear shortly after the administration of a mercurial diuretic or an adequate amount of digitalis. The shadow is likely to reappear with the reaccumulation of fluid in the body.

STEPHEN N TAGER M D

**Spontaneous Hemopneumothorax** Report of a Case Occurring in a Soldier John Franklin *Ann Int Med* 23 437-441, September 1945

The apparent rarity of spontaneous hemopneumothorax led the author to report the following case.

The patient was a 23-year-old soldier, complaining of severe right upper abdominal and right anterior chest pain which radiated to the right shoulder. Chest roentgenograms made on induction, a year before, were reported clear. The temperature on admission was 100°, pulse 110, respirations 30, blood pressure 90/70 mm Hg. The skin was a sallow yellow color, and the mucous membranes were pale. Respirations were rapid, laboring, and shallow, and the patient held his right side as he breathed. There was no cough. In the upright position, flatness to percussion was present

from the eighth rib downward posteriorly on the right. Breath sounds and vocal and tactile fremitus were absent over the entire right chest.

A chest roentgenogram confirmed the clinical impression of a hydropneumothorax. A complete collapse of the right lung, with a fluid level approximating the eighth rib posteriorly, was demonstrated. The trachea and heart were displaced to the left, and herniation of the mediastinum had occurred. A diagnostic thoracentesis resulted in the removal of air and blood under pressure. Approximately 700 c.c. of air were removed and 25 c.c. of blood with a red cell count of 3,160,000 and a white cell count of 6,900. With the removal of air from the right chest, the patient experienced immediate relief of respiratory distress, and a noticeable shift of the mediastinum toward the midline occurred.

On alternate days beginning on the third hospital day, four subsequent thoracenteses were performed, with removal of a total of 2,700 c.c. of grossly bloody fluid showing a decreasing red cell count from 3,160,000 to 510,000 and a rising relative eosinophil count from 18 per cent to 43 per cent. The fluid white cell count never rose above 9,850. In each instance the fluid obtained was sterile. Search for acid-fast bacilli was made and none was found.

Serial chest roentgenograms showed a decreasing fluid level and progressive re-expansion of the right lung. The lung at the last examination had entirely re-expanded, the costophrenic angles were clear, and there were no parenchymal changes to suggest pulmonary tuberculosis.

Although the equilibrium of increased pleural pressure and lowered blood pressure is probably effective in controlling bleeding, the respiratory embarrassment and incipient circulatory collapse occasioned by the acute and massive loss of blood in this case, plus the marked mediastinal displacement, forced the author to relieve the pleural tension and replace the blood loss. It is difficult to estimate accurately the acute blood loss. As the patient's body weight was about 57 kg, the loss was probably in excess of 30 per cent of the total blood volume, which is considered the limit beyond which the physiologic mechanisms of replacement fail. At the time of the first thoracentesis no clinical or roentgenographic evidence of continued bleeding was present.

This case falls into the category of those variants in the clinical picture of hemopneumothorax in which the signs and symptoms are referred to the abdomen. Right upper quadrant pain and tenderness, radiation of pain to the right shoulder, nausea and vomiting, and the yellow pallor suggestive of icterus were confusing features.

The pathogenesis of the hemopneumothorax was not determined. No evidence of tuberculosis could be found. The presence of ruptured emphysematous blebs has been observed in several cases which have come to the autopsy table, and pleural bullae also have been demonstrated radiologically. These constitute a ready source for the escape of air into the pleural cavity and one needs but postulate the presence of a valve vesicle to explain a tension pneumothorax. The source of the bleeding may well be from the ruptured vesicle itself, as these bullae are richly vascularized. A more likely possibility is that bleeding results from an adhesion torn by the traction of the collapsing lung.

STEPHEN N TAGER, M D

Two cases of measles pneumonia in adults, with roentgen and necropsy findings, are presented

**Coccidioidomycosis in Southern California Report of a New Endemic Area with a Review of 100 Cases** Forrest M Willett and Alvin Weiss *Ann Int Med* 23 349-375, September 1945

The authors report a series of 100 hospitalized cases of pulmonary coccidioidomycosis from a new endemic area in Southern California, a roughly triangular desert region bounded by Needles and Banning, Calif., and Yuma, Ariz. The patients were soldiers who had been assigned to this area and were about equally divided between the white and black races. The disease was found to be of greater severity in the colored group.

The authors discuss in rather full detail the various phases of coccidioidomycosis as observed in this series and report several illustrative cases, including one with autopsy findings. Roentgenographic findings were of great value both in diagnosis and in following the course of the disease. For these, reference is made to the papers of Carter (see *Radiology* 38 649, 1942) and others.

**Primary Bronchopulmonary Aspergillosis, an Occupational Disease** George C Coc *Ann Int Med* 23 423-425, September 1945

A case of primary bronchopulmonary aspergillosis is reported, believed to be the first in the history of this country to come before the Industrial Commission of a sovereign state and to be declared an occupational disease, legally compensable.

The patient was a man of 47, with symptoms of ten years' duration—cough, dyspnea, and weakness. The cough had always been productive, occasionally of a black, streaked sputum, but had never been associated with hemoptysis. The patient had been employed at the Union Stock Yards, in varying capacities, for approximately twenty years. His work at all times brought him into intimate and prolonged contact with animals and with heavy concentrations of dust, including that of hay, grain, corn, and straw.

A florid cyanosis and audible rhonchi were evident at least 5 feet from the patient. The superficial veins of the anterior thorax were prominent, and a bilateral respiratory lag was noted. The heart was not enlarged, blood pressure was 115 mm Hg systolic and 80 mm diastolic, pulse 110 per minute.

Roentgen examination of the lungs showed emphysema with increased pulmonary linear striations especially on the left side, adhesions of the left diaphragm near the cardiac apex, pleural thickening in the upper chest on both sides, especially the left, and massive lung root shadows, especially on the right.

Sputum examination and cultures were made and a typical *Aspergillus fumigatus* was isolated. The tuberculin patch test was definitely positive and a scratch test for *Aspergillus fumigatus* was questionably positive.

The history, physical examination, and roentgen-ray study were indicative of a far-advanced pulmonary fibrotic condition with pleural and bronchial involvement.

Molds of the genus *Aspergillus* are regular inhabitants of soil and are frequently isolated from cereal products, unmilled grain, hay, and other stock feeds, the spores being mingled with grains, seeds, and flour. *Aspergillus*

*fumigatus* is the most common offender in infections of the bronchopulmonary tissue. The principal factor in the pathogenesis of the disease seems to be exposure to repeated massive doses. In such instances, the condition may be primary without any preceding pulmonary disease.

STEPHEN N. TAGER, M.D.

**Putrid Pulmonary Abscess Without Foul Sputum (Shut-off Pulmonary Abscess)** Daniel Stats and Harold Neubof *Arch Int Med* 76 154-160, September 1945

The early appearance of fetid sputum establishes the diagnosis in about 95 per cent of cases of acute putrid pulmonary abscess. In the remaining 5 per cent, foul sputum either does not appear at all or is found much later than usual, presumably because of occlusion of the communicating bronchus as the result of an inflammatory reaction. On the basis of this assumed mechanism, the term shut-off pulmonary abscess seems appropriate for such cases. Absence of drainage through the bronchial tree favors spread of the abscess to the pleura. Pain in the chest is a more frequent and persistent symptom in these cases than in draining pulmonary abscesses. It is often apoplectic in suddenness and severity and is incapacitating. Once established, it tends to persist for days or weeks. Cough and expectoration are minimal or absent. Physical examination is not of decisive diagnostic assistance.

The densities and rarefactions seen on the roentgenogram in cases of shut off abscess may be difficult to interpret. They are of no aid in differentiating between a putrid and a non-putrid infection. When the pulmonary lesion is small, its roentgenographic counterpart is relatively insignificant. In one of the authors' cases nothing more than a small area of pulmonary infiltration was observed. In another, in which a large abscess was subsequently demonstrated, an extensive subapical density with the characteristics of a tuberculous or neoplastic infiltration was seen. A fluid level in an abscess cavity usually means a fairly free communication with a bronchus. In most cases of shut-off abscess, the complicating pleural involvement obscures or modifies the pulmonary shadow to such a degree that it becomes unrecognizable in the films. The familiar shadows of a localized or total pleural effusion or hydropneumothorax may be seen. The presence of multiple fluid levels usually means a loculated pyopneumothorax. The roentgen picture in cases of infra-pulmonary or interlobar pyopneumothorax is often difficult to interpret. In such instances the general impression is that of a large pulmonary abscess with a fluid level. In all cases of suspected putrid pulmonary infection lateral and oblique views of the thorax should be made. Occasionally sectional roentgenograms are necessary for correct interpretation and accurate localization of the lesion.

Operation is imperative for the shut off pulmonary abscess. In 2 of the 10 cases summarized here, operations were not performed in one because the expectoration of foul sputum on one occasion after four weeks of mild illness represented the evacuation and spontaneous subsidence of a small abscess and in the other because the diagnosis was not made. In this series, there were 2 deaths, 1 of which was avoidable. There are grave dangers inherent in a long delayed diagnosis but there is a likelihood of a correct diagnosis if the possibility of the lesion is borne in mind. The excellent

pericardial metastasis Symptoms first appeared while the patient was on a hike, from which he had to drop out Three days later he was hospitalized and a diagnosis of pericarditis was made Three weeks after this, at a station hospital, the cardiologist made a provisional diagnosis of pericarditis subsequent to an acute arteritis with myocardial infarction

Several roentgen studies showed a progressive enlargement of the heart The transverse diameter increased from 15.5 cm to 21 cm in three months In the beginning the enlargement was limited to the left ventricular apex and weak pulsations were observed in that area Within a month, feeble pulsations only were observed over the entire left ventricular border

About three months after the onset of symptoms, the patient became orthopneic A short, sharp, harsh systolic aortic murmur was heard The heart rate was 100 Mild cardiac decompensation was apparent clinically Dependent pitting edema developed, and the sclerae showed an icteric tinge At this time, a chest film showed the left border of the heart to be in contact with the axillary chest wall, with apparent displacement of the heart to the right, and displacement of the lower end of the trachea and right main bronchus

The original EKG showed evidences of pericarditis with possible myocardial infarction Subsequent EKG's showed persistent evidences of myocardial damage The final clinical diagnosis was "massive aneurysmal dilatation, left ventricle, probably on the basis of myocardial infarction, with subsequent myocardial failure"

Approximately four and a half months after onset of symptoms, the soldier died Postmortem examination showed the extreme cardiac enlargement, which involved primarily the left ventricle, to be due to a mass which extended half way around the heart by intracardiac growth *en cuirasse* Its exact site of origin could not be determined but was thought to be in or near the apex of the left ventricle The cavity of this ventricle was reduced in size, and two polypoid masses were present in its apical portion The right ventricle was hypertrophied but was not invaded by tumor tissue Another mass, measuring  $2.2 \times 4.5$  cm, surrounded the base of the aorta, producing some compression on the superior vena cava as it entered the right auricle This periaortic mass was entirely extramyocardial and had no connection with the main tumor It was thought to be an intrapericardial metastasis Microscopic sections of the tumor tissue showed a spindle-cell type growth, believed to be leiomyosarcoma

An antemortem diagnosis of tumor was suggested in this case but discarded in favor of aneurysm In retrospect, the authors feel that the latter diagnosis should have been excluded for the following reasons (1) the presence of a friction rub for ten days is unusual in a case of simple single infarction, (2) there was no drop in blood pressure, (3) the EKG changes were not typical, (4) there were no clinical or other laboratory data to support secondary infarction to account for the progressive nature of the EKG findings, (5) the rapid enlargement of the heart, coupled with the rapid course, should have pointed to tumor as the more probable diagnosis

HENRY K. TAYLOR M.D.

**Anomalous Right Subclavian Artery** Benjamin Copleman Am J Roentgenol 54 270-275, September 1945

A review of the embryological and anatomical features of anomalous right subclavian artery is given

The site of origin of the anomalous vessel is most often the posterior aspect, and only rarely the superior wall of the aorta Since the anomalous artery arises on the left as the fourth rather than as the first or part of the first main trunk, it must cross the spine to reach the right arm It usually runs between the esophagus and the spine, and its course is upwards, as well as to the right Patients with right subclavian artery anomaly occasionally complain of dysphagia Because of pressure on the artery there may be inequality of the radial pulses

Roentgenologic examination of the patient while he swallows a barium meal shows an indentation of the esophagus posteriorly by the anomalous artery This is the sole diagnostic clue The defect is concave to the left and is at or above the level of the aortic arch The esophageal defect produced by a right aortic arch is almost the same as that due to an anomalous right subclavian artery The aortic anomaly displaces the esophagus to the left and anteriorly The demonstration of a normally pulsating aortic arch, which is not in contact with the esophageal defect, at the left side of the vertebral column, must be made in order to arrive at the true diagnosis

A case presenting the characteristic defect of anomalous right subclavian artery is described

CLARENCE E. WEAVER, M.D.

## THE DIGESTIVE SYSTEM

**Peptic Ulcer in a Naval Hospital, 1944** Some Roentgenologic Findings L. Henry Garland Stanford M. Bull 3 114-120, August 1945

General medical conceptions as to the incidence and diagnosis of peptic ulcer are based largely on civilian experience The author, on the basis of his observations in naval hospitals, believes that some revision of prevailing opinions is called for He analyzes here a group of 1,000 cases in young patients (average age 26 years) with short histories (many less than two years) The ratio of gastric to duodenal ulcer in this group was approximately 1 to 24 As given in the literature the ratio ranges between 1 to 3 and 1 to 50

The diagnosis of peptic ulcer is made from (a) the clinical history, (b) the laboratory findings, and (c) the roentgenologic or gastroscopic demonstration of the lesion The most important diagnostic procedure is the roentgenologic The demonstration of a crater is the only definite x-ray evidence of an active ulcer, either gastric or duodenal

As to the significance of bulbar deformity without a niche, the author believes that, if the patient has had no previous upper abdominal surgery and the deformity is constant, there is a 95 per cent probability that it is due to ulcer or to scarring ("healed" ulcer) A single examination showing deformity is not proof of an active ulcer, deformity visible on repeated examination is indicative of ulcer, active or healed

The author asks Can healing of a peptic ulcer be reliably diagnosed by x-ray examination? In the case of most gastric lesions, his answer is, "yes" In about one-half of the cases of duodenal ulcer, he believes the answer is, no Many authorities have held that, once a duodenal ulcer is present, the bulb will never be smooth again However, the author has seen many young men with normal appearing duodenal bulbs who a few months previously had unequivocal craters, 2 to 5 mm in diameter He believes, therefore, that the old state-

**Roentgenographic Study of the Postero-Inferior Pleural Boundaries Preceding Renal Surgery** Ernest Leuchman Urol & Cutan Rev 49 463-467, August 1945

For the urological surgeon the postero inferior extent of the pleura is of great importance. In its inferior extent it is overlapped by the upper poles of the kidneys and is thus liable to injury in renal surgery, with the production of an accidental pneumothorax.

The posterior inferior pleural border is seen in a dorsoventral roentgenogram as a line running either horizontally or with medial ascent or downward convexity from the lateral thoracic wall toward the spinal column. This line, representing the posterior costo-diaphragmatic reflection of the pleura, may occur anywhere from the level of the twelfth dorsal to the lower margin of the second lumbar vertebra. It is best demonstrated with the patient prone, in deep inspiration. Variations in the form and position of the pleural line are considerable. The downward bulge of the postero-inferior pleura, in particular, may be much lower than one would assume from anatomical descriptions. In extreme instances, unless this has been demonstrated roentgenologically, the surgeon may open into the pleural cavity. In addition to locating the lower boundary of the pleural sac, an abdominal film with the patient prone will furnish information as to the size of the twelfth rib. When the latter is rudimentary, the eleventh rib may be mistaken for the twelfth, with a consequent distortion of the topographical anatomical picture.

MAURICE D. SACHS, M.D.

**Electrokymograph for Recording Heart Motion Utilizing the Roentgenoscope** George C. Henny and Bert R. Boone. Am J Roentgenol 54 217-229, September 1945

That each chamber of the heart and associated great vessels has its characteristic motion, and that this motion is characteristically altered in the presence of cardiovascular disease, has been well established. The permanent graphic recording of this motion is a goal long desired and sought for. It is believed there will be a substantial gain in the clinical information furnished by the analysis of heart motion. The records obtained by means of the electrokymograph described here overcome past difficulties encountered in the analysis of the roentgen kymogram, in producing a large, beam type or electrocardiographic type tracing of a chosen point on the cardiac silhouette on bromide paper, of as many consecutive cardiac cycles as may be desired.

Under the roentgenoscope the roentgen-ray beam is restricted to a narrow rectangular area with its long dimension placed so as to be at right angles to the particular portion of the heart border under investigation. The heart border will appear to move across this rectangle. A 931-A multiplier phototube is placed over this area. The roentgen-ray beam is channeled through a lead diaphragm system which restricts the rays striking a strip of fluoroscopic screen, which in turn activates the phototube in varying intensities produced by the motion of the heart border. The emitted current is greatly amplified in the tube and further by an amplifier which then operates a recording galvanometer. The observer aligns the 931-A diaphragm by means of the fluoroscopic screen. The amplifier is described in considerable detail. The recording galvanometer is of the permanent magnet d'Arsonval type,

such as is used in electrocardiography. A recording of the right carotid pulse is made simultaneously on each patient and registers on the film below the heart motion tracing.

The electrokymograph has these advantages over the roentgen kymograph: (1) It records a single point of motion at one time. (2) It records as many successive cardiac cycles of this point as may be desired. (3) It produces amplitudes on the record up to 20 mm or more by amplifier adjustment. (4) It records wave forms on the record which are sharply defined and easily read. (5) It shows the "radial motion" of a point and not merely its horizontal component because the aperture of the unit containing the phototube is placed roentgenoscopically at right angles to the border of the heart under examination.

Records of motion from various parts of the heart border are presented in the text and their interpretation is discussed. With alterations in character of the myocardium, or defects of the valves, there will be corresponding alterations on the limbs of the curves produced on the electrokymographic record.

CLARENCE E. WEAVER, M.D.

**A Roentgen Cinematographic Study of the Movements of the Mitral Ring During Heart Action.** Henning Odqvist. Acta radiol 26 392-396, June 30 1945.

Odqvist reports a roentgen cinematographic study of a woman of 76, who for some years had shown signs of cardiac sclerosis. Following study of the heart under routine fluoroscopy, he made a powerful exposure over a period of three seconds at 100 kv and 100 ma, using a specially constructed fluorescent screen of high luminosity. During this time the cinematographic exposures were made with a 16 mm camera fitted with a Zeiss Optik, Roentgenbiotar, f 0.85 objective, on Cine Kodak film XX, 16 as well as 32 exposures a second were made. The point is stressed that the registering of intracardiac calcifications and their movement approaches the borderline of present-day technical achievement. "Only where the patient is very lean and the calcareous deposits considerable can success be expected."

The movement curve of the calcified mitral ring during heart action is described as triangular. During ventricular systole, the movement of the ring is vertically downward in the direction of the diaphragmatic cupola. Just before reaching its lowest position it moves with a jerk toward the apex of the heart. Diastole produces a returning movement along the hypotenuse of the triangle, at the upper part of which the deposit stops and appears to vibrate. This is followed by a quick return to the original position at a speed considerably greater than the other movements, which is presumed to represent the presystolic phase.

The author raises the question whether the described movements constitute a physiological phenomenon or whether they should be considered as a sign of uncoordinated contractions of the heart muscle due to perimitral calcification extending into the surrounding myocardium or to coronary disturbance, both of which were known to be present. VICTOR KREMFENS, M.D.

**Unusual Primary Leiomyosarcoma of the Heart.** Burt Friedman, Ernest E. Smard, and Irving Schwartz. Am Heart J 30 299-308, September 1945.

The authors give the case history of a 35-year-old soldier with a primary tumor of the heart with an intra

pericardial metastasis. Symptoms first appeared while the patient was on a hike, from which he had to drop out. Three days later he was hospitalized and a diagnosis of pericarditis was made. Three weeks after this, at a station hospital, the cardiologist made a provisional diagnosis of pericarditis subsequent to an acute arteritis with myocardial infarction.

Several roentgen studies showed a progressive enlargement of the heart. The transverse diameter increased from 15.5 cm to 21 cm in three months. In the beginning the enlargement was limited to the left ventricular apex and weak pulsations were observed in that area. Within a month, feeble pulsations only were observed over the entire left ventricular border.

About three months after the onset of symptoms, the patient became orthopneic. A short, sharp, harsh systolic aortic murmur was heard. The heart rate was 100. Mild cardiac decompensation was apparent clinically. Dependent pitting edema developed, and the sclerae showed an icteric tinge. At this time, a chest film showed the left border of the heart to be in contact with the axillary chest wall, with apparent displacement of the heart to the right, and displacement of the lower end of the trachea and right main bronchus.

The original EKG showed evidences of pericarditis with possible myocardial infarction. Subsequent EKG's showed persistent evidences of myocardial damage. The final clinical diagnosis was "massive aneurysmal dilatation, left ventricle, probably on the basis of myocardial infarction, with subsequent myocardial failure."

Approximately four and a half months after onset of symptoms, the soldier died. Postmortem examination showed the extreme cardiac enlargement, which involved primarily the left ventricle, to be due to a mass which extended half way around the heart by intracardiac growth *en cuirasse*. Its exact site of origin could not be determined but was thought to be in or near the apex of the left ventricle. The cavity of this ventricle was reduced in size, and two polypoid masses were present in its apical portion. The right ventricle was hypertrophied but was not invaded by tumor tissue. Another mass, measuring  $2.2 \times 4.5$  cm, surrounded the base of the aorta, producing some compression on the superior vena cava as it entered the right auricle. This periaortic mass was entirely extramycardial and had no connection with the main tumor. It was thought to be an intrapericardial metastasis. Microscopic sections of the tumor tissue showed a spindle-cell type growth, believed to be leiomyosarcoma.

An antemortem diagnosis of tumor was suggested in this case but discarded in favor of aneurysm. In retrospect, the authors feel that the latter diagnosis should have been excluded for the following reasons: (1) the presence of a friction rub for ten days is unusual in a case of simple single infarction, (2) there was no drop in blood pressure, (3) the EKG changes were not typical, (4) there were no clinical or other laboratory data to support secondary infarction to account for the progressive nature of the EKG findings, (5) the rapid enlargement of the heart, coupled with the rapid course, should have pointed to tumor as the more probable diagnosis.

HENRI K. TAYLOR, M D

**Anomalous Right Subclavian Artery** Benjamin Copleman. *Am J Roentgenol* 54: 270-275, September 1945.

A review of the embryological and anatomical features of anomalous right subclavian artery is given.

The site of origin of the anomalous vessel is most often the posterior aspect, and only rarely the superior wall of the aorta. Since the anomalous artery arises on the left as the fourth rather than as the first or part of the first main trunk, it must cross the spine to reach the right arm. It usually runs between the esophagus and the spine, and its course is upwards, as well as to the right. Patients with right subclavian artery anomaly occasionally complain of dysphagia. Because of pressure on the artery there may be inequality of the radial pulses.

Roentgenologic examination of the patient while he swallows a barium meal shows an indentation of the esophagus posteriorly by the anomalous artery. This is the sole diagnostic clue. The defect is concave to the left and is at or above the level of the aortic arch. The esophageal defect produced by a right aortic arch is almost the same as that due to an anomalous right subclavian artery. The aortic anomaly displaces the esophagus to the left and anteriorly. The demonstration of a normally pulsating aortic arch, which is not in contact with the esophageal defect, at the left side of the vertebral column, must be made in order to arrive at the true diagnosis.

A case presenting the characteristic defect of anomalous right subclavian artery is described.

CLARENCE E. WEAVER, M D

## THE DIGESTIVE SYSTEM

**Peptic Ulcer in a Naval Hospital, 1944** Some Roentgenologic Findings. L. Henry Garland. *Stanford M. Bull.* 3: 114-120, August 1945.

General medical conceptions as to the incidence and diagnosis of peptic ulcer are based largely on civilian experience. The author, on the basis of his observations in naval hospitals, believes that some revision of prevailing opinions is called for. He analyzes here a group of 1,000 cases in young patients (average age 26 years) with short histories (many less than two years). The ratio of gastric to duodenal ulcer in this group was approximately 1 to 24. As given in the literature the ratio ranges between 1 to 3 and 1 to 50.

The diagnosis of peptic ulcer is made from (a) the clinical history, (b) the laboratory findings, and (c) the roentgenologic or gastroscopic demonstration of the lesion. The most important diagnostic procedure is the roentgenologic. The demonstration of a crater is the only definite x-ray evidence of an active ulcer, either gastric or duodenal.

As to the significance of bulbar deformity without a niche, the author believes that, if the patient has had no previous upper abdominal surgery and the deformity is constant, there is a 95 per cent probability that it is due to ulcer or to scarring ("healed" ulcer). A single examination showing deformity is not proof of an active ulcer, deformity visible on repeated examination is indicative of ulcer, active or healed.

The author asks: Can healing of a peptic ulcer be reliably diagnosed by x-ray examination? In the case of most gastric lesions, his answer is, "yes." In about one-half of the cases of duodenal ulcer, he believes the answer is, no. Many authorities have held that, once a duodenal ulcer is present, the bulb will never be smooth again. However, the author has seen many young men with normal appearing duodenal bulbs who a few months previously had unequivocal craters, 2 to 5 mm in diameter. He believes, therefore, that the old state-



ment that healed duodenal ulcer "typically shows some contraction" no longer holds.

The findings relative to uncomplicated peptic ulcer in the 1,000 consecutive upper gastro intestinal examinations constituting the basis of this paper were as follows

Unequivocal x ray diagnoses of ulcers	321
Gastric ulcers	13
Duodenal ulcers	308
With definite craters	164
With probable craters	24
Without visible crater	120

It is of interest to note that craters were demonstrable in 61 per cent of the duodenal lesions

In order to determine the consistency with which duodenal ulcer can be diagnosed by different members of a radiological staff, a group of cases which had been examined by different radiologists was reviewed. In 130 consecutive cases, Dr A diagnosed duodenal ulcer in 28 per cent and Dr B in 30 per cent. In only 6 cases were reports at direct variance. Three of these differences may be written off as attributable to the natural history of the disease (that is an interval of about six weeks occurred between examinations), the other three probably represent errors or oversight. The consistency and accuracy with which duodenal ulcer can be diagnosed appear, therefore, to be excellent in experienced hands.

In the x-ray diagnosis of duodenal ulcer the reliability of the various criteria is estimated as follows

- (1) Niche Active ulcer in 95% of instances
- (2) Deformed bulb Active or healed ulcer in 95% of cases (provided there has been no previous operation on the duodenum)
- (3) Smooth bulb (with and without compression)  
No ulcer in first portion of duodenum in 95% of cases
- (4) Deformed bulb, inconstant or without niche  
Usually due to incomplete filling, with pylorospasm, etc. Occasionally due to duodenitis with or without shallow erosion

Since many clinicians believe that an x-ray report of duodenal ulcer means or implies active ulcer, the author believes that qualification of the report should be attempted, along the following lines

- (1) Duodenal ulcer, with visible crater
- (2) Duodenal ulcer, with questionable crater
- (3) Duodenal ulcer, with no crater visible, deformity typical, presumably active
- (4) Duodenal bulb deformity, probably scarring from healed ulcer
- (5) Duodenal bulb deformity, probably surgical
- (6) Duodenal bulb deformity, probably extrinsic
- (7) Negative

The author emphasizes the importance of a standard procedure for the determination of partial pyloric obstruction which may complicate a juxtapyloric ulcer, and recommends barium sulfate (4 oz by weight) in water (8 oz by volume) at room temperature. He notes, in passing, that barium is often incriminated as a cause of intestinal obstruction when in fact it is merely a concomitant of a pre-existing or incipient fecal impaction attributable to faulty diet or medication in a dehydrated patient (aluminum hydroxide may produce hard, white colonic masses which resemble and may be

miscalled barium lumps when viewed with the naked eye)

The data on the consistency of reports of ulcer or a sense of ulcer by different radiologists are of considerable interest and should be studied in the original article

SYDNEY F THOMAS, M.D.

#### Gastrojejunal Fistula Henry K Ransom Surgery 18 177-190, August 1945

Of 47 patients operated upon for gastrojejunal ulceration at the University of Michigan Hospital in a ten year period (1934-44), 8 (17 per cent) had a complicating gastrojejunal fistula. The number of such complications diagnosed since the opening of the hospital in 1925 was 18, in 14 of which operation was done.

Gastrojejunal fistula is almost invariably a late complication of a marginal or jejunal ulcer developing at the site of a gastroenteric anastomosis for duodenal ulcer. The great majority of cases occur after posterior gastrojejunostomy, usually following a simple short circuit operation rather than in gastrojejunostomy associated with partial gastric resection. In the 18 cases forming the basis of this report duodenal ulcer was the initial lesion in all. Marginal ulcer rarely occurs following gastroenterostomy for gastric ulcer and is almost unheard of after gastroenterostomy for carcinoma of the stomach. The exact cause of marginal or jejunal ulcer is not known, but it is believed to develop most frequently in those patients in whom gastric acidity remains high following operation.

The interval between the original operation and hospital admission for fistula varies. The extremes in the present series were one year and twenty six years, with an average of nine and a half years.

Clinical diagnosis of gastrojejunal fistula is ordinarily not difficult, and in the author's series was made correctly in all except one instance. Symptom due to the recurrent ulcer may or may not precede the typical symptoms of fistula. Of the latter, diarrhea is the most prominent and distressing and is chiefly responsible for the weight loss and the debilitated state of the patient. Vomiting is probably the second most important symptom. It is often described as fecal but is not actually stercoraceous as in small bowel obstruction. Pain is usually present in those patients with evidence of marginal ulcer prior to the onset of fistula symptoms. It is more severe and less responsive to medical treatment than the primary ulcer pain and is often situated to the left of and slightly below the umbilicus. Obstruction may occur in the colon at the site of the perforation and the symptoms may then be those of bowel obstruction. In other instances the small bowel may be obstructed as a result of adhesions around the inflammatory mass at the site of the fistula. An anemia of moderate degree is usually present, and serum protein determinations are likely to be below normal.

Roentgen studies with the aid of the barium meal and barium enema are undoubtedly the most important means of proving the presence of a gastrojejunal fistula. The diagnosis is often suggested or made when, following oral administration barium is seen fluoroscopically to enter the colon promptly. When the fistula is small, however, or if the barium enters the colon slowly, the condition may be overlooked. In 15 of the 18 cases reported here the fistula was demonstrated roentgenologically.

Due to the cachectic state of the patients, preoperative correction of the nutritional disorders is essential. In all of the author's series a one-stage operation was done. Gastric resection was included in 4 instances, in the remainder the simpler restorative types of surgery with or without pyloroplasty were employed. There were 2 operative deaths, but the last 10 consecutive operations were performed without a fatality. In 3 cases the end results were excellent and in 4 good. In 5 there was a recurrence of symptoms, and re-operation was required.

A brief discussion of gastrocolic fistulas due to primary disease of the stomach or colon is included, and a small group of gastro-enteric fistulas attributable to surgical errors is presented.

J E WHITELEATHER, M D

**Lesions of Small Intestine Producing Massive Hemorrhage with Symptoms Simulating Peptic Ulcer**  
Harry L Segal, W J Merle Scott, and J S Watson  
J A M A 129 116-120, Sept 8, 1945

The primary purpose of this paper is to emphasize the fact that various lesions of the jejunum or ileum may produce melena and postprandial pain, thus mimicking peptic ulcer. The findings in 9 such cases, 6 of which have been reported previously in the literature, are summarized. Included are 2 instances of benign leiomyoma, 2 of Meckel's diverticulum, 2 of hemangioma, 1 each of carcinoid, benign neurofibroma, and carcinoma.

Of importance to roentgenologists is the fact that the diagnosis was not made by the first x-ray examination in any of these patients. Actually, in 6 different instances there were roentgenologic changes in the duodenal bulb which led to the erroneous conclusion that the symptoms were due to duodenal ulcer.

Careful examination of the small bowel is indicated in any patient who has pain which is somewhat atypical for peptic ulcer and repeated or continuous melena in the absence of hematemesis.

JOHN F HOLT, M D  
(University of Michigan)

**Roentgen Diagnosis of Jejuno-Ileal Inflammations**  
Pedro A Maissa Radiologia 7 162-170, July-October 1944

The roentgen findings in inflammatory lesions of the jejunum and ileum, particularly in regional ileitis and tuberculosis, are described and compared with those in the normal small intestine. The methods used in roentgen examination are discussed and the importance of serial studies is emphasized. The author concludes that roentgenography can determine only the existence, but not the nature, of the disease process.

**Diverticulitis of the Jejunum with Perforation**  
Michael W Shutkin Gastroenterology 5 102-105, August 1945

The developmental cycle of jejunal diverticula is reviewed. It appears that such diverticula represent sacular hernias of mucous membrane through a gap in the bowel wall at a point where blood vessels enter. When stasis in the sac occurs, diverticulitis and even perforation may result. A survey of the less than one hundred recorded cases of jejunal diverticulosis fails to establish a definite syndrome for the uncomplicated lesion. The more common symptoms are pain, flatu-

lence, borborygmus, and vomiting, the attacks increasing in frequency. Roentgenography is most helpful in the diagnosis of diverticula of the jejunum but is not without shortcomings. The roentgen diagnosis depends upon the demonstration of one or more constant barium shadows of hemispherical outline presenting a fluid level with gas. This is usually observed with the patient in the upright position. Contrary to the prevalent opinion that stasis in the sac is uncommon because of the fluid character and motility of the contents of the gut at this level, retention and impaction occur. This happens not uncommonly with inert substances such as barium sulfate and aluminum silicates, and delays in emptying of from twenty-four to thirty-six hours have been reported.

A case of diverticulitis of the jejunum with perforation, believed to be the first in which a preoperative diagnosis was confirmed at operation, is presented.

**Right Paraduodenal Hernia** Frank H Lahey and William Trevor Ann Surg 122 436-443, September 1945

The rarity of right paraduodenal hernia is pointed out. Only 2 cases were seen in the Lahey Clinic from 1925 to 1944 and only 2 cases were treated at the Mayo Clinic from 1910 to 1939. The ratio of right paraduodenal hernia to left is 1:3. Fifty cases (including the present 2) have been recorded in the literature, operation was performed in 31 of these, and about half the patients survived.

In right paraduodenal hernia, according to Moynihan, (1) almost all of the small intestine is imprisoned in a peritoneal sac behind the ascending and transverse mesocolon and occupies the right half of the abdomen, (2) the opening of the sac is to the left and near the duodenojejunal juncture at the ligament of Treitz, (3) the superior mesenteric artery or a continuation of it, the ileocecal artery, lies in the anterior portion of the sac.

The 2 cases reported in this paper were not diagnosed roentgenographically, but in retrospect the authors believe the correct diagnosis might have been made in the first case because of the presence of certain roentgenographic features described in the literature (Exner, F B Am J Roentgenol 29 585, 1933 Abst in Radiology 22 642, 1934). (1) the appearance of the small intestine, as though it were contained in a spherical transparent paper bag from which restricted position it is usually impossible to disturb the intestinal coils by manual palpation or postural change, (2) the location of the intestine well above the true pelvis. In the second case the following points, set forth by Case and Upson (J A M A 87 891, 1926), should have suggested a correct diagnosis: (1) the normal location of the jejunum on the right side of the abdomen, (2) downward continuation of the jejunum from the second portion of the duodenum, (3) absence of the transverse third and ascending fourth portions of the duodenum traveling to the left across the spine, (4) dilatation of the duodenum as a result of constriction or angulation of the proximal jejunum by the neck of the peritoneal sac.

Diagrams of the operative findings and embryonic development of the intestine clarify the presentation of the subject. The reproductions of the roentgenograms leave much to be desired.

SADNEY F THOMAS, M D

**Volvulus of the Sigmoid Colon** Report of Twenty-Five Cases William D Griffin, George R Bartron, and Karl A Meyer Surg, Gynec & Obst 81 287-294, September 1945

Of 458 cases of intestinal obstruction seen in the Cook County Hospital (Chicago) between 1937 and 1945, 37 (8 per cent) represented volvulus of the sigmoid colon. Twenty-five of these cases for which complete data were available form the basis of this paper.

Volvulus of the sigmoid colon occurs predominantly in males, and the greatest incidence is in middle and advanced life. The authors' cases were of two general types—acute and subacute. The acute cases occurred in the younger age groups, the patients gave an equivocal history of constipation, early transient emesis, generalized cramping abdominal pains, abdominal tenderness, acute distention, and severe prostration. There was a tendency to the early development of gangrene and a fulminating course. Subacute cases were slightly in the majority in this series. These patients were older, and the onset was more gradual, with a history of previous attacks and constipation. Emesis was of late occurrence, gangrene developed slowly and the course was more moderate.

Seventy-six per cent of the patients were unable to take an enema of more than 500 cc (the normal capacity in the absence of obstruction is 2 or 3 liters). When the volvulus was incomplete, however, 3,000 cc might be introduced in the redundant loop of sigmoid colon, but only a small portion of this amount could be expelled. Since only 24 per cent of the patients showed this valve like action, however, it is not considered pathognomonic.

The most helpful single aid to diagnosis is the roentgen examination. The typical findings, according to the authors, are a tremendously dilated sigmoid loop situated in the right side of the abdomen, moderate distention of the colon above the volvulus, absence of a collection of fluid within the bowel, an "ace of spades" appearance of the barium enema opacity, and a normal mucosal pattern in the sigmoid and rectum distal to the dilated loop. The authors are not in agreement with Rigler and Lipschultz (Radiology 35 534, 1940) that the presence of an unusual amount of fluid is a diagnostic feature.

The clinical course and response to surgical intervention were quite variable. Simple detorsion, even when possible, did not appear to be the treatment of choice since the volvulus tended to recur. Exteriorization and second-stage resection of the bowel probably gave the best results. R E BOOTH, M D

**Regional Segmental Colitis** Jorge de Castro Barbosa, J Arnold Bargen, and Claude F Dixon S Clin North America 25 939-968, August 1945

The term "regional colitis" is applied to inflammatory, ulcerative, or hyperplastic lesions of cryptogenic origin involving one or more segments of the colon, either as a continuous process or multiple involvement, sparing, however, the terminal portion. The 140 cases constituting the authors' series were seen at the Mayo Clinic in a twenty-year period (1923-43) and represent about 4 per cent of the entire group of cases of colitis observed in that time. While the right side of the colon was more frequently involved than the left, the authors feel that the term "right-sided colitis," sometimes used, is not entirely justifiable, particularly since they exclude all cases with primary involvement of the ileum.

The disease is equally distributed between male and female patients, it is most common in the third and fourth decades but may occur at any age.

The etiology remains undetermined despite numerous studies. No single infective agent has been consistently found as a causative factor. Allergic reaction of the viscera, disturbed function of the visceral sympathetic system, and visceral infarction may all play a part. The experimental focal thrombotic phenomenon produced in the digestive tract by anaphylactic shock may correspond to the areas of "stippling" seen at operation in segments of bowel near inflammatory lesions. The present authors consider the "stippling" as indicating the initial inflammatory lesion and point out that resection should go beyond any "stippled" areas if recurrence is to be prevented.

To classify accurately the location and extent of the lesions in their cases, the authors arbitrarily divided the colon into fourteen small segments from the cecum to the distal sigmoid. They found an average of seven segments involved in each case. The segments of the right half of the colon, as pointed out above, were more frequently involved than those of the left, the transverse colon was more commonly involved than the ascending colon. The proximal segments of the left half of the colon were also a common site of involvement. In 18 per cent of the series there were secondary lesions in the terminal ileum. In the majority of cases, a single short or long continuous inflammatory lesion was present. In four instances, two separate lesions with normal bowel between them were demonstrated. In one case, a patchy distribution was present.

Pathologically the lesions were similar to those of generalized ulcerative colitis with diffuse mucosal ulceration, polypoid hyperplasia, suppuration of the submucosa, thickening and induration of all coats, and chronic infiltration with scarring of the serosa.

Clinically the patient may be in good general condition and complain only of abdominal cramps with an occasional loose stool, infrequently bloody, or there may be an acute illness, with fever, evidence of toxemia and bodily depletion, severe diarrhea and hemorrhages. There are many variations between these extremes but in general the diarrhea is not severe, the rectal discharges contain little if any pus or blood, cramps are common along the line of the colon and may be relieved by bowel movements. Some evidence of anemia is common though gross hemorrhages are rare. The sedimentation rate is a good guide to the activity of the disease.

Since the lesions are beyond the reach of the proctoscope and sigmoidoscope, the diagnosis depends almost entirely on the radiologic findings. The fuzzy, distorted and narrowed outline of the involved segments, with evidence of hyperirritability, shortening, and loss of haustration, is characteristic of segmental colitis. Double contrast enemas may add further evidence. Differentiation from carcinoma is not usually difficult unless the involved area is exceptionally short, when it may be impossible to reach a decision from roentgen evidence alone.

Many patients in this group were treated medically with or without sulfonamides. Bed rest, intravenous fluids, blood transfusions, low-residue high-protein and vitamin diets, and other general supportive measures were used. Forty-three patients underwent some form of surgical procedure.

The authors conclude that one must follow these patients for years before a decision can be made as to the efficacy of any form of therapy, that sulfonamides with supportive measures are often effective in obtaining remissions and in preparing patients for surgical intervention, that short-circuiting operations are seldom effective, and that resection of the involved segments is the treatment of choice, with the best chance for permanent cure. **BERNARD S. KALAYJIAN, M.D.**

**Radiological Aspect of Amebic Colitis** J. J. Val-larino *Radiologia* 7 150-161, July-October 1944

Roentgenography is of considerable value in the study of amebic colitis, giving information not only as to the location, extension, and seriousness of the intestinal invasion, but also on the course of the infection under treatment. The differentiation of amebic colitis from ulcerative colitis, mucous colitis, tuberculosis, and cancer is discussed.

**Roentgenological Diagnosis of Benign Tumors (Single Polyps) of the Colon** Franz J. Lust *Am J Roentgenol* 54 276-281, September 1945

Bleeding from the rectum and intestinal obstruction are the important signs which should lead to a search for intestinal polyps. Most of the polyps are very vascular and therefore easily damaged by hard fecal matter. Obstruction is usually partial. The patient may experience no pain except after taking laxatives or cleansing enemas. In one of the author's cases the pains were localized in the right hypochondrium. The best way to find a polypoid growth of the colon (unless it can be reached by the proctoscope) is by enema. The study of the mucous membrane after evacuation of the barium enema is stressed. Air insufflation is advisable, but interpretation must be made cautiously, as fecal material may be mistaken for a polyp. Careful preparation of the patient for barium enema study is most essential. In the presence of polyps, the regularity of the mucosal pattern is suddenly interrupted. The tumor appears like a cherry or plum in the axis of the colon. For further study a compression device must be used.

The author reports two cases of polyp of the colon which were diagnosed by roentgen study and removed surgically. Another case is described in which a mass resembling a polyp proved, on re-examination, to have been fecal material, demonstrating the value of thorough preparation. **CLARENCE E. WEAVER, M.D.**

**Gallbladder Dye (Iodophthalein Sodium) Effect of Intravenous Injections on Coronary Flow, Blood Pressure and Blood Coagulation** Florence E. Lawson *Arch Int Med* 76 143-145, September 1945

Experiments with the intravenous injection of iodophthalein sodium showed that this dye produces an increase in the coronary flow in dogs, while a drop in the blood pressure was observed in both dogs and human beings. The fall in blood pressure may account for the occurrence of shock in some cases following injection of the dye for gallbladder studies. In patients with sclerotic arteries, the drop in blood pressure may produce enough diminution of coronary flow to result in coronary thrombosis.

While the mechanism of the production of coronary accidents by intravenous injection of gallbladder dye

in persons with coronary arteriosclerosis is not fully explained by the experiments here recorded, it is clear that both blood pressure and coronary blood flow are profoundly affected. Obviously intravenous cholecystography is contraindicated in persons with coronary arteriosclerosis.

Two cases of anaphylactic shock without coronary occlusion and 2 cases in which coronary occlusion occurred after administration of iodophthalein sodium are presented.

## THE MUSCULOSKELETAL SYSTEM

**Osteogenic Sarcoma and Chondrosarcoma, with Special Reference to the Roentgen Diagnosis** Eugene P. Pendergrass, John O. Lafferty, and Robert C. Horn *Am J Roentgenol* 54 234-256, September 1945

This paper is an attempt to evaluate the difficulties and pitfalls in the roentgen diagnosis of primary malignant bone tumors and to correlate the pathologic findings with the roentgen picture. In 1939 the original Registry of Bone Sarcoma of the American College of Surgeons was revised, one of the principal changes being the recognition of the chondrosarcomas as a distinct group. The authors have followed this revised classification in their series.

Seven cases of osteogenic sarcoma with their histories are presented. Eleven cases in which a diagnosis of chondrosarcoma was established are also described.

Sclerosing osteogenic sarcoma is described as occurring characteristically on the shaft side of the epiphyseal zone and showing mottling due to destruction and sclerosis within the bone. The growth may extend beyond the epiphyseal zone. The cortex is incompletely preserved. The periosteum is raised above or below the tumor, producing periosteal lifting. Spicules of new bone are laid down perpendicular to the cortical surface, producing the "sun-ray" appearance. Osteolytic osteogenic sarcoma manifests itself roentgenographically by a central area of irregular destruction which eventually extends through the cortex. It is asymmetrically located and there is periosteal reaction. The soft tissues may be involved in either type. In many cases the two types are co-existent. Periosteal elevation and lifting constitute one of the earliest signs of osteogenic sarcoma and should be carefully watched for.

Chondrosarcoma may be central or peripheral. The central growths may begin in the medulla or in the cortex. They show large thick-walled cavities tending to destroy the cortex. They occur in the ends of the long bones and perforation of the cortex is a late occurrence. The peripheral tumors show a faintly visible shadow in the soft parts next to the bone, raising the adjacent periosteum. Radiating spicules are often present. These are quite long and show a flattened outer surface as distinguished from those of osteogenic sarcoma, which are shorter and do not become flattened. All cases had one finding in common—spotty flecks of calcification seen in the tumor. It is believed that this is a significant finding in the differential diagnosis of these lesions by the roentgenogram.

Three cases are presented which have the roentgen characteristics of one lesion and the pathologic characteristics of another. These demonstrate that accurate diagnosis cannot always be made from the roentgen examination alone. Other cases which showed lesions of bone having characteristics that might cause them to be confused with osteogenic sarcoma and chondro-

sarcoma were Ewing's tumor, metastatic carcinoma, osteomyelitis, periostitis, and hemangioma of bone. Perpendicular striations may occur in chondrosarcoma, periostitis, and metastatic carcinoma. Before radical surgical treatment is instituted, biopsy should be done and an adequate specimen obtained. Frozen sections are quite often not sufficient. The need for a skeletal survey in all cases of suspicious bone lesion is emphasized.

All of the patients with osteogenic sarcoma in this series were treated by immediate amputation, and all died, the longest survival being twenty nine months. Four of the eleven patients with chondrosarcoma survived, one for eight years and one for six years. Two others had been treated within the last fifteen months. The differences in the clinical course and survival rate suggest that these two groups of tumors should be separated, as recommended by the Bone Tumor Registry.

CLARENCE E. WEAVER, M.D.

**Sarcomatous Change in an Osseous Exostosis** J. Ducuing and P. Marquès. *J de radiol et d'électrol* 26: 20-21, 1944-45.

This case represents what appeared to be an osteochondroma (in the nomenclature ordinarily employed in America) of large size, situated on the scapula. It was followed from 1937 to 1941, when extension and change in form and density led to a biopsy, with the resultant diagnosis of chondrosarcoma.

The authors comment that this is a rather rare development in an osteochondroma, a statement which will find general acceptance, though their publication serves as a reminder that one must not disregard this possibility in considering the many benign osteochondromas which are seen by the average radiologist from time to time.

PERCY J. DELANO, M.D.

**Metastases and Neoplastic Dissemination Involving the Osseous System in Cancer of the Cervix** Bonte and Schaffner. *J de radiol et d'électrol* 26: 1-3, 1944-45.

Osseous metastases from carcinoma of the uterine cervix were not frequently observed. Gricouff found only 25 examples in a series of 2,076 cervical cancers. Fourteen cases have been seen by the authors, all established radiologically or at autopsy. The vertebral column was involved in 6 of the series: the neck of the femur in 4, iliac bone in 2, humerus in 1, tibia in 1, shaft of the femur in 1.

In 9 cases the lesions appeared within six months following treatment, in the remainder an interval of about eighteen months elapsed. As to the form of treatment, all but one of the patients had received radiotherapy, in one, hysterectomy was done.

Age did not appear to be of significance, nor did the histology of the lesions have any constant bearing.

The authors note that in lesions of the spine the disks were preserved. All of the metastases shown in the illustrations are of the osteolytic type, though one case is said to be of the osteoplastic type, somewhat fenestrated with osteolytic areas.

In most of the cases, the appearance of osseous metastases was a harbinger of early death. In a single case, radiotherapy to the bony lesions had left the patient in a comfortable state, with outward evidence of good health, three and a half years after the lesions appeared.

PERCY J. DELANO, M.D.

**Bone Growth in Congenital Myxedema. The Use of Serial Roentgenograms of the Os Radius in Diagnosis and Regulation of Therapy During Infancy** Paul V. Woolley, Jr., and Robert W. McCammon. *J. Pediatr* 27: 229-235, September 1945.

Three cases of cretinism are presented to illustrate the value of roentgen studies of the long bones, both in the diagnosis of athyreosis and in the regulation of therapy in young children. Two features are stressed. First, a hard, densely calcified epiphyseal plate, which is present by the time cretinism is suspected clinically, is as dependable a finding as retardation in the appearance of ossification centers. This plate does not resemble that seen in rickets, scurvy, syphilis, or lead poisoning and has not been encountered by the authors except in films of myxedematous patients. Second, the administration of thyroid substance results in an almost immediate resumption of growth and the appearance of newly calcified bone. Adequate treatment at first produces calcification at a rate greater than average for normal infants, later, growth which parallels the normal curve. Reduction of thyroid intake is reflected by decreased bone growth, and this decrease can be measured roentgenographically before outstanding clinical signs of deficiency appear.

These observations can easily be employed in the differentiation of thyroid deficiency from other states characterized by retardation in growth and development. The administration of thyroid substance should be reflected visibly in the long bones within three to four weeks if a true lack is present, if not, no changes will be observed.

No attempt has been made to extend this standard beyond two years of age, since bone growth is considerably slower thereafter and since other norms for thyroid function are easily applicable to older children.

A curve expressing the growth of the radius in infants without evidence of thyroid deficiency is reproduced.

**Brucellar Spondylitis** S. Di Rienzo. *Rev argent neororteam cien méd* 1: 737-761, January 1944.

Vertebral involvement, particularly of the lumbar region, is fairly frequent in brucellosis. The lesions occur either in the body of the vertebra or in the soft parts, especially in the intervertebral disk. The peripheral vertebral structures may be simultaneously affected or react later in order to consolidate the healing of the lesion. During the initial phase of the process there is an alteration in the shape of the vertebral angles, which may no longer be present in a profile view, and the parallelism between the planes of adjoining bodies is lost. Frequently there are impressions or marks, sometimes deep depressions, in the vertebral bodies. This period is followed by one of definite destruction, with disappearance of the intervertebral disk and fusion of the vertebral bodies. The period of repair begins with an increase in the opacity of the affected region, due to the deposition of calcium salts. The ligaments also become impregnated with calcium and are visible roentgenologically, giving the appearance of "bridges" uniting the vertebrae spikes which approximate the bones, or 'lips' which join them. Not all of the above lesions reach the same stage of development at the same time, and while some vertebral lesions are in the destructive period others may be in the initial or the repair stage. The presence of multiple lesions in different stages of evolution is a characteristic feature of

brucellar spondylitis and must be borne in mind in the differential diagnosis. Appropriate clinical and laboratory studies are necessary to establish the diagnosis. Fifty illustrations accompany this paper.

**Massive Extrusions of the Lumbar Intervertebral Discs** A Ver Bruggen Surg, Gynec. & Obst 81 269-277, September 1945

The author reports 9 cases of acute compression of the cauda equina by a massive lumbar disk extrusion, seen in about 300 consecutive cases of typical herniated nucleus pulposus with sciatica but without bladder symptoms or incapacitating weakness. Eight of the cases were confirmed at operation, the ninth patient died of intercurrent disease before operation could be carried out. This condition represents a serious complication of herniated disks and constitutes a neurosurgical emergency. In spite of early effective treatment, it may lead to permanent disability.

All but one of the patients gave a history of backache for years, 3 gave a history of trauma. Symptoms were characteristically intermittent with a "cog-wheel" progression, i.e., successive acute short episodes. Sciatica had been present in all but 2 cases for years.

The signs were those of compression of the cauda equina, including weakness of the legs below the knees, saddle anesthesia, and sphincter disturbances. Lasègue's sign was positive in 8 patients, and 6 had tenderness over the spinous processes on deep pressure. The deep reflexes at the ankle were affected in all the cases and those at the knee in some. Spinal fluid examination showed a complete block in 3 patients.

The location of the extrusion was at the lumbosacral joint in 3 cases, between the 4th and 5th lumbar vertebrae in 3 cases, and between the 3rd and 4th lumbar vertebrae in 2 cases. Roentgenograms showed narrowing of the affected interspace in 5 cases. Preoperative myelography was not done in any instance.

In discussing the differential diagnosis, the author emphasizes the steady progression of symptoms in metastatic carcinoma of the spine and the short history of two to three weeks in Pott's disease. The history is shorter, also, in patients with cord tumors. Tenderness over the spine and a positive Lasègue's sign are rare in cord tumors. The roentgen examination may be negative in all of the above-mentioned conditions.

Laminectomy was performed in 6 cases and an interlaminar approach was used in 2. The diagnosis was confirmed by histologic examination of the tissue removed. Two patients were able to return to their usual occupations. Six noted improvement in bladder control strength in the legs, anesthesia, and pain. One patient was still incontinent three and a half years after operation and one still had a paraplegia two and a half years later. None of the patients had pain of any severity at the time of the report.

The reason for the slow recovery is not apparent. In 2 of the cases, myelography was done after operation and showed some deformity at the operative site, but the fluoroscopic findings were considered to be within normal limits. The case in which operation was performed within the shortest interval following the onset of symptoms showed the most incomplete recovery.

With the possibility of such a disabling complication, the author points out, it is not always safe to allow the usual type of herniated disk to remain untreated.

Each case is reported in detail.

FRANK P. BROOKS, M.D.

**Congenital Syphilis of Bones and Joints** Arthur Steindler Urol & Cutan Rev 49 568-575, September 1945

At times, the clinical diagnosis of congenital syphilis is not easy. In such instances, the roentgenogram may be of invaluable aid in establishing the diagnosis.

A distinction is made between congenital syphilis manifested in the fetus or early infancy and syphilis seen in later infancy. The earlier type is characterized by an osteochondritis and periostitis. There are three phases of osteochondritis: (1) irregularity and broadening of the calcification zone ("barbed-wire" formation), (2) the appearance, in this zone, of yellow or gray soft granulation tissue which extends into the cartilage and may cause a separation of the epiphysis and metaphysis, (3) eventual degenerative changes in the granulation tissue leading to a separation of the epiphysis from the diaphysis. In the late stage of osteochondritis the roentgenograms, especially of the lower end of the femur, tibia, radius, ulna, and phalanges, reveal a transparent zone (granulation tissue) bordered by two narrow layers of calcification. Periostitis is often combined with the osteochondritis and is apparent on the roentgenograms of the long bones as laminated onion-skin layers completely ensheathing the shaft. Diaphyseal osteomyelitis also occurs in early congenital syphilis following the stage of osteochondritis and periostitis, but is rare. It is a gummatous infiltration of the long bones and may be localized or general. The roentgenogram reveals a diffuse rarefaction or a sharp punched-out area. Shafts of the phalanges may show a fusiform swelling.

In late hereditary syphilis, the predilection is for the shafts of the long bones. These show a hyperostotic periostitis and diaphyseal osteomyelitis. In early stages of the diaphyseal osteitis, there may be softening of the bone with a resultant bowing. Skull rarefaction is similar to that found in Schüller-Christian's disease. Gummatous lesions may also be present.

Healing in both early and late congenital syphilis, following specific therapy, is dramatic, with complete disappearance of x-ray findings and resumption of undisturbed growth of bone.

Joint involvement is rare in congenital syphilis. Syphilitic arthritis is either of the gummatous or non-gummatous type. The gummatous type may involve the synovia, with erosion of the cartilage, or may result in a "frozen joint" due to extension of the process from either the diaphysis or epiphysis. Roentgenograms reveal spotty rarefied areas with mushrooming of the articular condyle. The non-gummatous type produces joint effusion and responds promptly to specific treatment.

Syphilitic bursopathy is a painless enlargement of the knee with fluid in the extra-articular bursae. Hydrarthrosis of a joint is often associated with keratitis. Both lesions are resistant to specific therapy. Although Charcot joints are more usual in acquired syphilis, they are occasionally found in congenital syphilis.

MAURICE D. SACHS, M.D.

**Radiography in Rib Fractures** Raymond W. Lewis New York State J Med 45 1767, Aug 15, 1945

In rib injuries, as in head injuries, unless extensive damage or complications are suspected, it is more sensible to treat the patient for his injury and then, approximately six weeks to three months later, if for medicolegal or other reasons a precise diagnosis is desirable,

examine him roentgenographically. A recent rib fracture without any displacement is usually visible in a roentgenogram only if the rays happen to be directly parallel, or nearly parallel, to the fracture. Consequently, in the customary one to four views, the possibility of detecting a fracture is very slight. X-ray studies after sufficient time has elapsed for reparative changes to have taken place are much more reliable. Early examination causes unnecessary discomfort to the patient and delays institution of treatment.

**Case of Osteodystrophy of the Osteoclastic Type Involving the Tarsal Scaphoid.** P. Ingelrans, A. Venducure, and J. Nigoul. *J. de radiol. et d'électrol.* 26 23-24, January-February 1944-45.

The involved nomenclature employed in the title of this article seems merely to mean, judging from the illustration and from the pathologist's report, a giant-cell tumor. The patient was a girl of 18, and the clinical diagnosis was tarsal tuberculosis. X-ray examination revealed a tumor of the navicular, which appeared to be a typical giant-cell tumor. The case is reported because the tarsal navicular is not a common site of this neoplasm. The bone was removed.

PERCY J. DELANO, M.D.

**Calcification of the Two Superior Tendons of the Direct Anterior Muscle.** Estève. *J. de radiol. et d'électrol.* 26 22-23, 1944-45.

An anteroposterior view of the hip joint, illustrating this case report, shows a band of calcific density extending from the region of the anterior inferior iliac spine to the greater trochanter of the femur. It has the appearance of calcification in muscle and tendon and seems to represent the insertion of the gluteus medius or minimus, or possibly a portion of both. The authors report the case as an unusual example of calcification and state that it followed a history of trauma. Pathologically they classify it as generically of the same origin as Pellegrini-Stieda disease, and state that they have searched the literature in vain for a similar example. The case would therefore appear to be of more than ordinary interest, certainly it is an appearance which this abstractor has never encountered in a film.

X-ray therapy was tried, but without result, surgery was being contemplated at the time of publication.

PERCY J. DELANO, M.D.

## GYNECOLOGY AND OBSTETRICS

**Roentgenologic Localization of the Placenta (Placentography).** Raymond J. Scheetz, C. Allen Good and Arthur B. Hunt. *S. Clin. North America* 25 993-1004, August 1945.

In painless vaginal bleeding without obvious cause, in the third trimester of pregnancy, roentgen localization of the placenta may be of inestimable aid, substantiating or refuting a clinical diagnosis of placenta praevia. In or beyond the seventh month of gestation, the accuracy of such studies will be 90 per cent or higher, with no attendant risk to mother or fetus. Direct placentography will reveal the site in 85 to 90 per cent of cases, while indirect placentography will give additional evidence in those with inconclusive findings by the direct method. Examination prior to the seventh month is usually unsatisfactory.

In the great majority of cases the placenta will be seen in or near the uterine fundus, either on the anterior or posterior wall, in a few it will be found attached to the lateral walls. The placenta is usually ventral to the fetus. Its shadow is differentiated as a thickening of the uterine wall separated from the fetal shadow by a linear area of decreased density due to fetal subcutaneous adipose tissue. An anteroposterior and two lateral films of the entire abdomen, including the uterine fundus, are needed. One lateral film should be made with soft-tissue technic, the other with spine technic. Movement of the fetus during exposure can be reduced to a minimum, or eliminated entirely, by having the mother breathe deeply several times before the exposure is made. This hyperaerates her blood so that the fetus has a sufficient amount of oxygen.

If one cannot definitely locate the placenta near the fundus, or if the implantation appears to be lower than normal, indirect placentography is indicated. The use of air or contrast media in the urinary bladder after catheterization may be of help in directly visualizing the lower edge of the placenta when its attachment is low, or in indicating indirectly that it is low or central by displacement of the presenting part away from the bladder outline. Certain factors such as interposition of a fetal hand or forearm between the head and the bladder, blood clots in the lower uterine segment, fecal distention of the rectum, disproportion between the fetal head size and that of the inlet, and pelvic tumors may produce upward displacement of the fetal head and make the diagnosis inaccurate. Unless the contour of the bladder outline conforms to that of the fetal head, indicating transmitted pressure, great caution should be exercised in diagnosing placenta praevia.

The authors review their series of 97 patients on whom placental localization by roentgen studies was attempted. Their accuracy was 93 per cent. Their failures, they believe, were largely due to immaturity of the fetus, low implantations with indefinite findings, incomplete examinations, and films of poor quality. They are confident that the examination has merit, that it should be performed more frequently, and that indirect placentography should be used on all cases in which the direct method does not give conclusive evidence.

BERNARD S. KALAJIAN, M.D.

## THE GENITO-URINARY SYSTEM

**Case of Roentgenologically Observed Perirenal Edema after Therapy with Sulfanilamide Preparations.** Olallo Morales. *Acta radiol.* 26 334-338, June 30, 1945. (In English.)

Following the administration of a total of 24 gm. of several sulfanilamide preparations for a suspected bronchopneumonia, a 37-year old woman complained of pains in the left renal region, crystalluria, hematuria, and oliguria.

On the day following cessation of medication, roentgenograms of the abdomen showed the right side to be normal. On the left neither the renal nor the psoas contours could be distinguished. No concretions were observed. There were no visible changes in the lumbar spine, the dome of the diaphragm moved freely on both sides, no fluid exudate could be seen in the left pleura and no atelectasis was present in the left lung base. A normal urogram was recorded on the right side but on the left there was no excretion of contrast medium.

The author considered the above findings to justify a diagnosis of left perirenal edema

Roentgenography was repeated after intervals of ten and twenty days. Along with subjective improvement in the condition of the patient, the second examination revealed a partially distinguishable left renal shadow and a distinct but diminished excretion of the contrast medium. The left psoas contour was at this time still not demonstrable. Final roentgen examination after twenty days showed normal renal and psoas shadows on the left and uniform excretion of dye bilaterally.

The roentgenological differential diagnosis between perirenal edema and perinephritis is discussed. The usual accessory symptoms of perinephritis, viz., high diaphragmatic dome, pleural exudate, basal pulmonary atelectasis, and lumbar scoliosis are not present in perirenal edema.

Excellent reproductions of roentgenograms accompany the text.

VICTOR KREMENS, M D

**Urinary Schistosomiasis. Report of Two Cases in Maine.** Clinton N Peters, Roderick L Huntress, and Joseph E Porter. *J Urol* 54 301-306, September 1945

This timely article adds two cases of urinary schistosomiasis to the 35 previously reported cases diagnosed in the United States and Canada. The infestation occurs chiefly in the Mediterranean areas, where the snail which acts as the intermediate host is found. The organisms enter the skin, where a local inflammatory reaction is set up, followed by urticaria and eosinophilia. The ova reach the vesical mucosa from the venules and cause marked congestion, followed by necrosis, then fibrosis, and at times the deposition of calcium salts in the submucosa. Malignant change may occur.

The presenting symptom is usually terminal hematuria. Diagnosis is based on biopsy or demonstration of the organisms in the urine. Suspicion of infestation from the case history, symptoms, and blood picture is grounds for specific therapy, which consists in parenteral administration of an antimony compound, Fouadin.

X-ray signs that are rather characteristic, when present, are (1) dilatation and tortuosity of the pelvic ureters with a normal pyelographic picture above, (2) demonstration of calcification in the bladder wall.

The two cases reported occurred in brothers who had lived in Palestine. In one the organisms were demonstrated, in the other a clinical diagnosis was made. Both responded dramatically to treatment.

JOHN A COCKE, M D

**Asymptomatic Pyuria in Young Men.** Francis A Beneventi. *Am J Surg* 69 224-226, August 1945

Fifteen of 80 men who had complete urological studies at a naval mobile hospital in the tropics had no symptoms but were examined solely because of the presence of leukocytes in occasional specimens of urine. With one exception, the men were under twenty-six years of age, and all were considered to be in good physical condition. In 5 men a serious upper urinary tract condition was found—in 3 an anomaly of the kidney, in 1, a bilateral nephrosis, and in 1, a large stone of the kidney pelvis with consequent hydronephrosis on that side. Two of the remaining 10 men had inflammatory ureteral strictures while 2 had chronic prostatitis, in 6 instances

no disorder of the urinary tract could be found. This small series of cases emphasizes the importance of urologic investigation of any young man with leukocytes, either persistently or sporadically, in his urine.

**Chyluria. Clinical, Laboratory and Statistical Study of 45 Personal Cases Observed in Hawaii.** Shoyer Yamauchi. *J Urol* 54 318-347, September 1945

Chyluria is a clinical entity characterized by the presence of chyle in the urine, usually in association with microscopic or gross blood. It is seen most frequently in areas where filariasis is endemic, and the latter condition is usually regarded as the foremost predisposing cause, though, as in the author's cases, filariae may no longer be demonstrable in the blood or urine.

Chyle enters the urinary stream through a fistulous opening between the renal lymphatics and the caliceal fornix. This abnormal communication is due to a rupture of the fornix occurring as the result of increased intrapycelocaliceal tension, immediately attributable to urinary stasis. Urinary stasis is believed to act in two ways—in the first place, it leads to rupture of the fornix, in the second, it permits the entrance of urine into the perirenal tissues, veins, and particularly the lymph channels. Inflammatory stasis develops in the lymph nodes, which in turn aggravates the lymphatic varix characteristic of filarial disease. Thus a vicious circle is established, particularly if the cause of the urinary stasis is persistent or progressive.

In the author's series of 45 cases, the interval between the last exposure to filariae and the onset of chyluria ranged from a few months to forty-five years. The cases were divided about equally between the sexes. The course is described as "unpredictable." It may begin unexpectedly and last a few days, weeks, months, or even years, with periods of exacerbation or remissions of varying duration, or it may cease completely for varying periods and recur at regular or irregular intervals. The attacks may stop as suddenly as they began, in a matter of hours or days.

Symptoms include backache, urinary frequency, dysuria, a dusky pallor due to anemia from blood loss, and a peculiar wizened appearance as a result of loss of subcutaneous fat. The outstanding feature is the voiding of a milky urine, unilaterally or bilaterally, or first on one side and then on the other.

Pyelographic studies were done in 32 of the author's cases, revealing pyelovenous reflux in 3 cases, pyelolymphatic reflux in 6, pyelovenous and pyelolymphatic reflux in 13, and pyelotubular reflux in 2. In 8 instances no shadow was obtained. The author believes it safe to conclude that the reflux shadow, particularly of the pyelolymphatic type, is the characteristic pyelographic feature of chyluria.

Control of chyluria can be accomplished with little difficulty by repeated intrapelvic lavage with silver nitrate solutions, but the cause of urinary stasis must be removed, and the intake of fat must be limited following lavage.

ALTON S HANSEN, M D

**Roentgenologic Differentiation Between Hypertrophy of the Prostate and Vesical Uroliths.** Axel Renander. *Acta radiol* 26 329-333, June 30, 1945 (In English)

Renander presents 2 cases in which a hypertrophic lobe of the prostate bulging into the bladder was interpreted roentgenologically as a non-opaque vesical



uroolith In each case operation revealed the formation in question to be an enlarged tertiary lobe of the prostate. The original diagnosis of organic vesical urolith had been made following urography and air cystography, which in each instance revealed a homogeneous shadow the entire circumference of which was clearly outlined with no suggestion of a stalk. The point is made that the problem is purely a matter of roentgen ray projection, the invading prostate as visualized on the film obscuring the prostatic stalk and thus giving the impression of a free formation in the bladder.

Palugay's claim that a hypertrophic lobe of the prostate does not change its position in the bladder with change in the patient's position is emphasized as a differential diagnostic feature, but the author cautions against misinterpreting apparent changes in position.

VICTOR KREMFENS, M D

### THE BLOOD VESSELS

**Retrograde Arteriography in the Study of the Abdominal Aorta and Iliac Arteries** P L Tarnas Sur-  
gery 18 244-249, August 1945

In 1941 the author described a procedure for aortography with the aid of a urethral catheter (Am J Roentgenol 46 641, 1941 Abst in Radiology 39 121, 1942). In view of the difficulty, during the war, of obtaining rubber catheters, he has substituted a procedure which he designates as "retrograde abdominal aortography." In this method the femoral artery is exposed by blunt dissection, under local anesthesia, at the level of Scarpa's triangle and punctured with a trocar 1.5 mm in diameter. Through this trocar are injected 50 cc of a 70 per cent solution of diodrast in two and one-half to three seconds. Tourniquets must be placed at the roots of both lower extremities in order to avoid the passage of the contrast medium into the arteries of the legs. The Trendelenburg position may be required in certain cases. The opaque medium reaches a higher level during diastole and descends during systole, entering then into the branches of the abdominal aorta.

To avoid changes in pressure when the opaque substance is injected by hand, the author has designed an apparatus to maintain a constant pressure and rate of injection. It consists of a pump with a piston worked by an air compressor with a regulator and manometer. With a constant pressure of fifteen pounds it is possible to inject 25 cc of the opaque substance per second. The first exposure is made when 40 cc of the opaque substance have been injected and the second immediately afterward. A stitch is placed in the adventitia of the artery after the trocar is withdrawn.

Pathologic changes in the abdominal aorta and iliac arteries can be studied by this method; changes in contour, strictures, and dilatations are demonstrable. Aneurysms can be accurately localized and the degree of permeability of the aneurysmal sac, the presence of canalization and the degree of collateral circulation established. The author has had no accidents with the method.

J E WHITELEATHER, M D

**Treatment of Pulmonary Embolism** Lewis S  
Pilcher Am J Surg 69 190-203, August 1945

A review of the etiology and present treatment of pulmonary embolism emphasizes the fact that most emboli originate from free propagating thrombi in the

femoral venous system. The author discusses the use of femoral vein ligation in the prophylactic treatment of pulmonary embolism and evaluates the use of venography in the diagnosis and localization of femoral thrombi. With his method of venography, the dye is injected into the superficial vein at the internal malleolus or into one of the other superficial veins of the foot with the ordinary intravenous needle (size 19). Usually it is not necessary to cut down on the vein; a blood pressure cuff is placed around the upper, not the lower leg, as high up in the groin as possible, and inflated to 20 mm of mercury at the time of the injection. Thus the dye is held in both the superficial and deep veins during the x-ray exposure, giving a comparative silhouette of the two systems simultaneously. The comparative picture contributes additional diagnostic information.

In the normal venogram produced by this method of injection, three main venous trunks should be visible in the upper leg—the saphenous medially and the double shadow of femora and profunda centrally. The absence of one of these shadows is of great significance diagnostically. Similarly, in the lower leg, the three main systems of internal saphenous, anterior and posterior tibial should normally be present. It is important to have films of both legs with identical amounts of dye and identical technique, for in some instances with partial obstruction the vein shadow will not be absent but merely narrowed. Such narrowing can be definitely determined only by comparison with the venogram of the opposite (normal) leg.

Because of the possibility of iodide poisoning, every patient should be tested for iodide sensitivity by having him hold a few drops of the solution on the tongue before the intravenous injection.

Five cases are reported in which accurate diagnosis of femoral vein thrombi was made largely through the use of venography, and in which satisfactory results were obtained by ligating and partially resecting the involved femoral vein. In 3 cases, the pulmonary embolism occurred before the femoral vein ligation was performed. The ligation and partial resection of the femoral vein in addition to removing the danger of further pulmonary emboli, was found to have a beneficial effect on an associated thrombophlebitis.

### THE SPINAL CORD

**Devic's Disease: A Clinical Review and Case Report.** S J Silbermann J Nerv & Ment Dis 102 107-120, August 1945

Devic's disease, or neuromyelitis optica, is a morbid process involving two anatomically and physiologically independent neural structures, the spinal cord and the optic pathway. Clinically, a rather acute or subacute onset with a relatively short interval between the development of myelitic and visual deficiencies, with a progressive or regressive course is fairly typical. Death occurs in 50 per cent of the cases due either to ascending myelitis or to secondary complications. If the patient survives residual damage remains. Complete restoration of health has rarely been reported.

Until recently, almost all authors agreed upon an infectious toxic agent as the most probable cause of this disease; it is now believed that it may be the result of an anaphylactic reaction of the central nervous system. In the light of histopathologic and etiologic studies of

the so-called demyelinating diseases, modern investigators view Devic's disease, multiple sclerosis, diffuse sclerosis, and the encephalomyelites as basically identical processes, the difference being the location, intensity, and other individual variabilities

One of the unusual features of the author's case, in a colored woman of eighteen years, was the presence of a spinal block, with a roentgen picture that was fairly conclusive of an associated diffuse adhesive spinal arachnoiditis. It is quite possible that similar changes were present in the cranium. However, neither objective nor subjective evidence for such an assumption was available.

## FOREIGN BODIES

**Nomographic Calculation of X-Ray Localization Values** Solve Stenström *Acta radiol* 26 339-344, June 30, 1945 (In German)

Numerous errors may ensue if, in the x-ray localization of foreign bodies, the factor of magnification at the various depths of the object is neglected. The author describes a nomographic procedure which considers the different degrees of magnification and which permits rapid calculations in application of Larsson's method of localization (*Acta radiol* 22 704, 1941).

ERNST A. SCHMIDT, M.D.

## RADIOTHERAPY

### NEOPLASMS

**Treatment of Advanced and Inoperable Cancer. A Résumé of Current Trends Based on a Review of the Literature and Analysis of Personal Case Experiences** Wm E. Howes and Alfred L. Shapiro. *Surgery* 18 207-228, August 1945.

This paper is concerned primarily with the care of the patient with advanced cancer, inoperable at least in the sense that definite possibility of cure cannot be assured. It can be estimated that 80 per cent of all cancer patients, excluding those with small epitheliomas, will either primarily or secondarily require palliative care. The authors give a working classification of advanced cancer cases, present in outline form the more common conditions calling for palliation, and discuss methods of treatment. These include irradiation, surgery, pharmacologic therapy, physiotherapy, and psychotherapy.

Limitation of growth, diminution in size, control of secondary infection, and, on occasion, total ablation of the primary lesion or of individual metastases are the major objectives of roentgen therapy. In such tumors as the lymphoblastomas, Ewing's myeloma, and epitheliomas of the skin, pharynx, and cervix, radiosensitivity or accessibility of the lesion often contributes to a dramatic result. Local and lymphatic recurrences of breast cancer frequently respond to intensive irradiation. The interstitial use of radium or radon in squamous cell carcinoma, cancer of the rectum and bladder, and metastases from cancer of the breast may lead to arrest or destruction of the lesion. Radiation has also proved of palliative effect in laryngeal, esophageal, bronchiogenic, and gastric cancer in advanced secondary cervical lymphadenopathy, and the frozen pelvis.

Bone metastases particularly those secondary to mammary carcinoma and cancer of the testis and thyroid, often respond favorably to irradiation. Lymphoblastomatous, leukemic, and myelomatous infiltration of bone is also frequently benefited particularly in the initial course of therapy. Bone metastases of other origin respond less satisfactorily or not at all. Isolated pulmonary, pleural, and mediastinal metastases of the more radiosensitive tumor types have been known to recede with radiotherapy. Ascites due to peritoneal implantation by ovarian carcinoma may respond favorably, permitting prolongation of the period between tappings.

The various surgical measures for palliation are discussed in some detail, special mention being made of

control of pain by interruption of the pathways of the nerve impulses. Formidable surgical procedures in patients with incurable malignant growths have the sole object of mitigating or forestalling unbearable agony where the sufferer can, in the event of survival, look forward to a period of months or years free from pain. An operative death rate as high as 10 per cent is not as deterrent as in elective general surgery, since, where extreme suffering cannot be palliated, a surgical mortality cannot be construed as equally unwelcome.

Pharmacologic therapy includes the judicious use of analgesics, supportive measures, such as high-calorie diets and vitamin preparations, endocrine therapy as indicated, and local application of the sulfonamides, penicillin, and other ointments to infected, ulcerating, and fungating lesions.

Physiotherapy has little to offer in this field, though occasional employment of such measures as diathermy and moist heat may afford relief. Psychotherapeutically the attitude of the physician and thorough and sympathetic nursing care are of paramount importance.

The authors present a series of 42 selected cases of advanced and recurrent cancer referred to the Brooklyn Cancer Institute as "beyond attempts at cure." With three exceptions, all patients received secondary radiation, radium or radon therapy, usually in several cycles. The techniques used varied considerably, in view of the variety of neoplasms treated, but total amounts comprised adequate accepted tumor lethal doses in all instances. Primary resections were carried out in half the cases, most often by electrotherm cutting current, for symptomatic relief by excision of extensive infected, ulcerative, or fungating lesions. In most of the others, radical secondary resection with hope of tumor extirpation was carried out. In several instances radiation alone sufficed. All the patients were ambulatory, active, and in relative comfort at the time of the report. Survival periods ranged from two and a half to fourteen years, averaging four and a half years. In 24 patients presumptive cures and in 9 instances definite arrest were attained; the remainder were notably improved.

J. E. WHITELEATHER, M.D.

**Radium Therapy of Hemangioma.** Lester M. J. Freedman, Harold W. Jacob, and Lawrence G. Beinbauer. *Urol. & Cutan. Rev.* 49 560-567, September 1945.

The authors describe their method of contact radium therapy of hemangioma and report their results in a

series of 95 patients. Platinum needles, 190 mm in length, 17 mm in outside diameter, with a wall thickness of 0.5 mm, each containing 100 mg of radium element, were used. These were variously arranged, not over 10 cm apart, application was usually for one hour, though in thicker lesions this was extended to an hour and a half or two hours. A second treatment was given after an interval of six to eight weeks, a third in not less than four months, and a fourth in not less than six months. Rarely five or six treatments were required.

Seventy nine of the series of 95 patients were one year of age or less. One patient died at the age of three weeks with hemangiomatosis of the lungs and abdominal organs, and 3 failed to return after the first treatment. Excepting these, 107 lesions were treated, with a perfect result in 65 and definite improvement in 35. The best results were obtained in the "strawberry mark" or vascular nevi. Of the 7 failures, 6 were in nevi of the "flame" type (port-wine marks), but even in this group encouraging results were obtained.

MAURICE D. SACHS, M.D.

**Radio-Sensitive Parasellar Tumors.** Report of a Case. Walter S. Lawrence and Walter W. Robinson. South M. J. 38: 510-513, August 1945.

The authors preface their case report with a general discussion of pituitary and parasellar tumors. Their patient was a man of 25 seen by them in January 1944, with a history of polyuria and severe headaches. Loss of vision had begun the preceding September, when examination showed bilateral optic atrophy and contraction of both visual fields. On examination two months later a diagnosis of a chiasmal lesion with diabetes insipidus was considered and exploratory trans-frontal craniotomy was recommended but refused. Hormone therapy was ineffective, and loss of vision progressed to complete blindness. By December 1943, operation was considered useless, and x-ray therapy was suggested. This was begun early in January. After the fourth treatment vision had returned sufficiently so that the patient could control his movements about the house and his polyuria was markedly diminished. After the seventh treatment he made trips to a distant city alone. A month after the completion of his treatments, the sight of his left eye was 20/200 but only light perception was recovered in his right eye. His sexual powers, which had been impaired, were also improved.

Treatment was by the multiple port method at weekly intervals, approximately 300 r per treatment. The factors were 185 kv, 0.5 mm Cu and 10 mm Al filtration, 40 cm distance, and all radiation was given through a 5-cm cone. At the end of the fourth month the interval between treatments was increased to one month. The total dose in eight and a half months of treatment was 5,535 r.

The radiosensitivity of this growth suggests a true pituitary origin. The symptoms were rather characteristic of a chromophobe pituitary tumor, yet there was no roentgenographic evidence of expansion or erosion of the sella and no suprasellar calcification. The suggestion is made that this growth, although originating within the pituitary fossa, may have developed ectopically.

The authors point out that patients with symptoms of pituitary tumor should receive high-voltage therapy

before the advent of ominous visual disturbances even in the absence of positive roentgen findings.

MAX MASS, M.D.

**Carcinoma of the Esophagus.** A Survey of 332 Cases. Edwin Boros. Gastroenterology 5: 106-111, August 1945.

An analysis is made of the results of various forms of treatment in 332 cases of esophageal cancer seen at the New York City Cancer Hospital from 1922 to 1944. Eighty patients received intensive radiation therapy. They generally stood the treatment well. In only an occasional instance was there any elevation of temperature. There was sometimes improvement in deglutition but not sufficient to warrant the inference that it could be expected with any measure of certainty. A few patients gained weight, but for the most part the weight remained stationary or declined. Esophagoscopy revealed no evidence of shrinking of the tumor following irradiation, or any sign of abatement of the process. Congestion and edema in a pronounced form constituted the general picture. The length of life ranged from one to eleven months following irradiation. No details as to the method of treatment are given.

Seven patients were operated upon with a view to total extirpation of the tumor and the lesion was found to be inoperable. Gastrostomy was performed on 168 patients and, while relief in swallowing was experienced by some, no prolongation of life resulted. The operative mortality was high, 25 per cent. Twenty five of the 80 patients receiving radiation therapy also had a gastrostomy, but the results appeared the same as in patients having a gastrostomy only.

The author concludes that, in spite of everything so far devised, cancer of the esophagus is practically always fatal, the results of surgery have been almost uniformly bad.

**Clinical Results with Rotation Therapy in Cancer of the Esophagus.** Preliminary Report Based on 174 Cases. Jens Nielsen. Acta radiol. 26: 361-391, June 30, 1945 (In English).

In addition to a discussion of his experimental studies in rotation therapy of esophageal cancer, Nielsen presents his observations and results with this form of therapy in 174 cases treated at The Radium Center in Copenhagen. The theoretical basis of rotation therapy is discussed at length by the author and his associates in previous publications (see, for example, Acta radiol. 25: 95, 1944; Abst. in Radiology 46: 546, 1946).

Treatment is carried out under constant fluoroscopic control. "With fields so narrow that the volume dose, despite a very considerable tumor dose, is kept within moderate limits, it is only by screening that we can make absolutely sure that the beam is really centered on the esophagus during the whole of the rotation." The patient is seated on a stool which rotates about a vertical axis while the roentgen tube is in a fixed position with the central ray directed horizontally. The rotation time is usually ten to fifteen minutes. The patient is instructed through a speaking grill to lift his arms and place them over his head when it is observed by the operator that they come within the roentgen ray beam. If the lesion is situated so high that the shoulders come into the beam during the rotation, it is best to interrupt the irradiation during their passage. Allowances for deviation of the esophagus in relation to

the axis of the thorax during the rotation are made by arranging the diaphragm in such a manner that it can be displaced a few centimeters to each side by means of a Bowden cable manipulated from the control booth. A mouthful of barium paste is swallowed by degrees from time to time during the rotation, serving to mark the point of stenosis.

The curative tumor dose is about 5,000 r delivered over a period of five to eight weeks. One hundred and eighteen cases were treated with radiation of half-layer value of 0.3 mm Cu (180 kv, 6 ma, 2-3 mm Al) and 56 with radiation of half-layer value of 0.9 mm Cu (180-200 kv, 15-30 ma, 0.5 mm Cu). The focus-axis distance in all cases was 50 cm. The width of the axial field varied from 3 to 6 cm. The most suitable daily dose was found to be a tumor dose of between 100 and 200 r given in two sittings.

The cutaneous reaction is at the most a moderate dry epidermitis. General reactions were slight. Cicatricial stenoses or perforations following therapy created no particular problem.

No attempt is made to evaluate ultimate results of this form of treatment. In 20 per cent of the cases, treatment could be considered only as palliative, since a tumor dose of less than 3,000 r was given. Improvement of deglutition was marked in many cases. Freedom from symptoms or definite improvement was obtained in 117 cases. Twenty-five per cent of the patients were alive after one year, and 15 per cent after two years, as compared to 10 and 4 per cent, respectively, in earlier series not receiving rotation therapy.

The author believes that treatment of cancer of the esophagus will in the future be chiefly by radiation and preferably by the rotary technic. Results will be still further improved by the use of more penetrating radiation (million-volt roentgen rays).

Several photographs of the equipment used are reproduced.

VICTOR KREMENS, M D

**Carcinoma of the Breast. Study of 37 Cases.** George B Kent and Kenneth C Sawyer. Rocky Mountain M J 42 672-676, September 1945.

The authors begin with the statement that progress in the treatment of cancer of the breast has not been comparable to that in the treatment of other neoplasms. The rich bed of lymphatics in which the breast lies, the anaplastic nature of most of the growths, and the accessibility of the region to trauma contribute to this unhappy situation.

Of the present series of 37 patients, 40.5 per cent were between the ages of forty-five and fifty-four and 32.4 per cent were between fifty-five and sixty-four. The youngest patient was twenty-four and the eldest seventy-five. Involvement of the left breast was more frequent. There was demonstrable lymph node involvement in 40 per cent of the cases.

It is the authors' practice to remove the entire breast for frozen section diagnosis, however innocent the clinical appearance may be. Of this series, 70.2 per cent were of the scirrhous type, 21.6 per cent were adenocarcinoma, 4.1 per cent medullary carcinoma. There was a single case of Paget's disease. Ninety per cent of the tumors were of grades 3 and 4 (Broders).

The authors admit that their experience with preoperative roentgen therapy does not qualify them to offer an opinion as to its value. They have not favored it, however, because of the generally recognized

danger of infection and necrosis following subsequent surgery and also because of the delay in operation which is involved. Two cases in their series, however, which received preoperative irradiation elsewhere did well following operation. The authors question, also, the advisability of postoperative irradiation and cite Harrington's statement comparing the results with and without such treatment. He found that only 4.8 per cent more patients with lymphatic involvement who had received postoperative irradiation were living at the end of five years, whose lesions had been graded 3 or 4, while 4.2 fewer were living after ten years whose lesions were graded 1, 2, 3, and 4. [The italics are the abstractor's.] The authors' operative mortality was 4 per cent. The three-year survival rate was 75 per cent, the five-year rate 50 per cent, and the ten-year rate 15 per cent. In the group with axillary metastases the corresponding figures were 66 per cent, 25 per cent, and 7.5 per cent.

PERCY J DELANO, M D

**Lymphosarcoma of the Mediastinum in a Child—Results with Radiation Therapy. Nine Year Follow-Up Study.** Benjamin Kaufman. Arch Pediat 62 340-353, August 1945.

This article presents in full detail the case history of a child who had been under observation since infancy. A mediastinal enlargement was discovered early, and at the age of three years and three months a diagnosis of lymphosarcoma of the mediastinum was made by needle biopsy. Radiation therapy was then begun, 3,000 r (in air) being delivered to each of two chest ports, with subsequent reduction in the size of the tumor. Later, following the occurrence of diarrhea, radiation in moderate dosage was given over the back and abdomen. Subsequently lesions, presumably metastatic, were demonstrated roentgenologically in the right hip, skull, and radius. These lesions were also irradiated, dosage, however, was limited because of the parents' fear of the effects on epiphyseal growth.

Death occurred after a nine-year course. In summary the author comments: "Looking back over this long and painful history I am impressed that the recurrent lymphosarcoma metastases proved to be very much more radio-resistant than the original lesions and that they could have been halted probably only by much more intensive depth doses."

PERCY J DELANO, M D

**Results of Various Types of Treatment in Adenocarcinoma of the Endometrium.** Charles E McLennan. Am J Obst & Gynec 50 254-262, September 1945.

The author discusses the results of treatment of 225 women with uterine corpus carcinoma by x-ray, radium, and surgical methods. Of 111 who were treated over five years ago, 45 per cent were living, free of disease.

Thirty-one of the five-year series of 111 had been treated primarily elsewhere, while 80 were treated solely in the author's clinic. Of the latter group, 46 received radiation therapy alone, in 5 others treatment was originally limited to irradiation but hysterectomy was ultimately done for recurrence. Twenty-nine patients were treated by total hysterectomy, and of these 83 per cent lived more than five years free of disease, whereas only 22 per cent of those treated radiologically survived five years. The latter group

contained all the inoperable and "bad risk" cases, but the author feels that more might have been salvaged by liberalizing somewhat the criteria of operability. Of those treated elsewhere, many were admitted with vaginal metastases, following irradiation, 42 per cent of these lived for at least five years.

The "routine" or standard method of treatment for this disease up to July 1941 consisted of deep x-ray therapy—two and a half to three erythema doses at the tumor site delivered in 25 to 30 daily treatments, over approximately four weeks, followed by 5,000 mg hr of radium therapy within 100 hours, with total hysterectomy and bilateral salpingo oophorectomy four to six weeks later. Only 53 per cent of the patients received the "routine" treatment, though 71 per cent had "complete" treatment in the sense that total removal of the uterus was accomplished. Many of the patients could not complete the "routine" treatment because of complications which arose and others were not subjected to it because of contraindications listed in detail in the original article.

Of 114 patients followed less than five years, 66 received "complete" treatment, with 84.8 per cent surviving, 49 were given "routine" treatment (radium and surgery), with 93.8 per cent surviving, and 27 were given incomplete or no treatment, with 25.9 per cent surviving. The ultimate survival rate of the last group is expected to be very low.

The operative mortality for all patients was 5.8 per cent. When 3 patients with virtually hopeless prognosis are left out, however, that mortality drops to 3 per cent. The postoperative deaths, which are considered in detail, were due to complications in almost every instance.

Poor results are to be expected from treatment by radiation alone. Some patients may be salvaged by later hysterectomy for recurrent or persistent carcinoma. The results of giving full-tolerance doses of x-radiation have been so poor in this author's experience that the practice has been eliminated as a part of the "routine" treatment of many patients and greater dependence has been placed on radium and total hysterectomy, with distinct reduction in morbidity and mortality, although it is too early to draw conclusions as to end-results. Final results will depend to a considerable extent on the nature of the material presented for therapy, medical and surgical complications, age, weight, and nutritional status.

BERNARD S. KALAJIAN, M.D.

**Carcinoma of the Cervix Complicated by Pregnancy**  
J. Robert Willson. *Am J Obst & Gynec* 50: 275-283, September 1945.

While carcinoma of the cervix is rare during pregnancy (0.015 per cent in the author's series), it should be considered in the differential diagnosis of painless uterine bleeding. During the first trimester of pregnancy, bleeding usually indicates threatened abortion. If it does not cease after one week of bed rest, sterile vaginal examination, including visualization of the cervix, is imperative. The diagnosis of pregnancy can be confirmed and the bleeding site determined. Cervicitis or areas of decidual reaction on the cervix during pregnancy may be everted, friable and bleed easily on manipulation. Such areas cannot be differentiated grossly from carcinoma. Microscopic examination of a biopsy specimen should therefore be done by a pathologist thoroughly familiar with the

normal morphological variations in the pregnant cervix, which also must be differentiated from malignant change. If the microscopic diagnosis is questionable, treatment should be withheld until the sections have been reviewed by several competent gynecologic pathologists and, if necessary, new biopsy specimens have been obtained.

The prognosis for carcinoma of the cervix found during pregnancy is apparently as good as in the non-pregnant woman. The belief that the rate of local growth of the tumor is accelerated by pregnancy has not been substantiated, nor is there evidence that pregnancy increases the opportunity of spread of the disease into the surrounding tissues. There is, indeed, some evidence to the contrary, cited by the author. Naturally, far advanced carcinomas have a poor prognosis, but in those discovered early by the alert physician the outlook is good.

X-ray therapy should be started immediately after establishing the diagnosis in the first trimester of pregnancy. Abortion will usually occur during the third week of irradiation. Should it not occur or be incomplete, curettage should be carried out. The aim is to deliver 3,000 r to each parametrium, with radium insertion after the uterus has been emptied. The radium dosage is at least 5,000 mg hr—one-third to the uterus and two-thirds to the cervix.

During the early part of the second trimester, treatment is as described above, though the radiation is less effective because of the size of the uterus. Later in the second trimester, surface application of radium to the cervix followed by abdominal section, x-irradiation, and intrauterine radium therapy, is indicated. Unless the lesion is very small, delivery from below is contraindicated at that time because of danger of hemorrhage.

During the third trimester, the last method applies and often the baby can be saved without undue risk to the mother.

The author describes 6 cases of cervical carcinoma during pregnancy, 4 of which were discovered in the clinic with which he is associated. One patient refused treatment. Two of the remaining three have survived over five years.

BERNARD S. KALAJIAN, M.D.

**On the Treatment of Malignant Tumors of the Testis**  
Haakon Odegaard. *Acta radiol* 26: 345-352, June 30, 1945. (In English.)

Malignant testicular tumors, from a practical clinical standpoint, are classified into two main groups by the author: (1) seminomas and (2) malignant embryonal testicular tumors, "teratomas." The genuine sarcoma and the true carcinoma are so rare that they are considered to be of little significance.

Norwegian and American sources show testicular tumors to constitute 0.3 per cent and 0.5 per cent, respectively, of all malignant neoplasms in men. These tumors occur with equal frequency on both sides, and 81.8 per cent of the patients fall within the twenty to fifty-year age group. In about 10 per cent of cases the affected testis is ectopic.

Lymph node metastases have proved to be the founding element in treatment and prognosis. According to Grevillius (*Acta chir Scandinav*, Supp 48: 1937), metastases from seminomas and teratomas occur within a year in 62.5 and 92.6 per cent of cases, respectively. Higgins and Buchert (*Am J Surg* 43: 675, 1939) report supraclavicular lymph node

metastases in 15 per cent, lung metastases in 13.8 per cent, mediastinal metastases in 3.0 per cent, and spread to the inguinal lymph nodes in 4.8 per cent of cases.

The usual treatment today is orchiectomy with post-operative irradiation. It seems, however, from various reports, that with teratomas roentgen treatment does not prolong life, but with seminomas the survival period is increased.

At the Norwegian Radium Hospital, roentgen treatment is given to one iliac field, one field toward the lumbar region from the front, and one larger field toward the lumbar region from the rear (illustrative diagrams are given). One field is treated per day, six days in the week. The daily dose is about 350 r with 175 kv, 4 ma, 50 cm distance, 0.85 mm Cu plus 0.5 mm Al filtration. The total dosage is about 3,500 r to each field.

Twenty-one seminomas and 16 teratomas have been treated at the Norwegian Radium Hospital in the period 1935-41, 19 and 13 cases received adequate post-operative irradiation. Of the patients with seminoma, 11 survived, free from recurrence, two years or more, 8 of these three years or more, and 2 more than five years. Of those with teratoma, 4 survived for over two years, 3 of these for more than three years.

VICTOR KREMENS, M D

#### Teratoma of the Testis Report of Sixty-Five Cases

John L. Barner. *Am J Roentgenol* 54: 257-261, September 1945

Sixty-five cases of teratoma of the testis were observed at an Army general hospital, representing 7.86 per cent of all cases of malignant tumors. The necessity for an early diagnosis in testicular tumors cannot be overstressed. The most frequent symptom is painless swelling. In 6 cases the tumor was found on routine examination for other purposes. There is a tendency for the organ to retain its natural outline. It is usually smooth and freely movable. The mass does not transilluminate. In those cases which offer any question of diagnosis, it is believed a surgical exploration is warranted.

The treatment consists in combined surgery and irradiation. Adequate operation involves orchiectomy and removal of the cord with accompanying structures high at the internal abdominal ring. As early as the third to fifth day after operation, a course of external deep roentgen therapy is begun. In cases without metastases, the portals of treatment are over the operative site, the mid-abdomen, epigastrium, and posteriorly over the upper sacrum and abdomen, and flanks. When metastases are present or suspected, the fields are the same with the addition of a lateral abdominal field, anterior and posterior chest fields, and usually a field over the left supraclavicular region.

Follow up shows that 10.7 per cent of the patients in this series have died.

CLARENCE E. WEAVER, M D

#### Radium Therapy in Carcinoma of the Penis Wickham and Dauvilliers. *J de radiol et d'électrol* 26: 6-9, 1944-45

The authors review the results of others in the treatment of carcinoma of the penis and report their own experience with 45 cases. Of this group 26 were considered to be beyond hope of cure either because of extension or recurrence. Of the remaining 19 patients,

14 were treated by radium and of these 8 were well after periods of one to eight years. Radium puncture and surface application were used either separately or in combination.

The usual form of surface applicator was a moulage, individually designed in each case, with a tube-skin distance of from 1 to 5 cm. The dose varied from 1,300 to 20,500 r, calculated at the center of the penis. In one case, 13,000 r were given to the surface and 20,000 r deeply by puncture, following this, recovery ensued with restoration of a normal appearing organ.

The authors have apparently found that in the majority of cases the associated adenopathy is inflammatory. Radiotherapy of enlarged nodes is not advocated. If they do not disappear following treatment of the primary lesion, they may eventually be excised.

PERCY J. DELANO, M D

#### Supplementary Measures in Radium Therapy of Epitheliomas of the Penis and Evaluation of the Dose in Roentgens Lucien Dauvilliers and Marcel Frilley. *J radiol et d'électrol* 26: 3-4, 1944-45

The authors begin by commenting upon the difficulties of measuring gamma radiation in r units, due in some measure to variation in intensity with changes in the distance factor.

The first portion of the article will be of particular interest to physicists, as it concerns ways and means of arriving at an accurate estimate of the dosage received by the tissues irradiated. One example is cited, which is easily remembered and tends to remind one of the great variation in dosage with alteration of distance, i.e., the fact that between a distance of 20 mm and one of 22 mm, there is a 20 per cent variation in the amount of radiation received by the skin. The authors do not consider so much what is their probable maximum dose at the point of greatest intensity but rather concern themselves with the smallest dose received at the periphery of the lesion.

In cancer of the penis, the difficulties are not so great, because of the limited field. The authors consider that they achieve something like homogeneous irradiation in the involved areas.

PERCY J. DELANO, M D

#### Plasmocytoma of Temporal Bone J. C. Gros. *Arch Otolaryng* 42: 188-190, September 1945

An exploratory mastoidectomy in a patient with a slowly progressive Gradenigo syndrome of four years' duration, with tinnitus and deafness, trigeminal pain and paralysis of the fifth and sixth cranial nerves, revealed a plasmocytoma of the temporal bone, involving the middle ear, the mastoid, and the petrous apex.

Following the operation, the patient received high-voltage roentgen therapy. Over a three weeks' period (March 1-24) she was given 5,700 r at 30 r per minute to a field 8 x 9 cm. The area treated covered the entire petrous bone, the ear, and the mastoid. Treatment was discontinued for about five weeks because of the pronounced reactions in the auricular cartilage. All ocular pain had disappeared, but paralysis of the external rectus muscle persisted. The second course of treatment consisted of 4,000 r at 18 r per minute, over a seventeen-day period (May 3-20), to a somewhat more anterior field, so that the petrous bone itself could be irradiated. The external ear was carefully protected. At the end of the second course of treatment there was evidence of movement of the left eye. This

movement improved to the extent that there was only a slight strabismus in the extreme left position

#### X-Ray Treatment of Warts Everett E Seedorf Urol & Cutan Rev 49 404-496, August 1945

The prime purpose in all forms of therapy for warts is their complete destruction. It is the consensus among dermatologists that surgery should be used only as a last resort. Irradiation in the hands of an experienced physician has many advantages over other forms of therapy. It is painless, reactions are mild, there are no secondary infections, and cosmetic results are better. Whether radium or x-ray is used it is agreed that a single massive dose is preferable to fractional irradiation. Radium is not as adaptable to use as x-ray. Coalescent warts should be destroyed, a portion at a time, by electrodesiccation.

The surface of a plantar wart should be peeled before treatment by radiation. The average dose for such warts is 1,200 r (80 to 120 kv with practically no filtration). With smaller lesions, comparably larger doses are required, but even for the smallest ones 1,800 to 2,000 r is usually enough. If the diameter exceeds 1 cm, the dosage should be reduced proportionately.

A verruca that has been given two treatments within a three month period and has failed to respond completely, or has recurred, should not receive further irradiation.

MAURICE D SACHS, M D

#### On Keloids and Their Treatment. Sverre Strand Acta radiol 26 397-408, June 30, 1945

A review of the more recent European literature on keloids and their irradiation treatment is given along with a discussion of the histogenesis and pathogenesis of this clinical entity.

The technic of treatment with radium at the Norwegian Radium Hospital is presented. A radium-mold with radium skin distance of 0.7 cm and filtration of 0.7 to 1.0 mm platinum is used. The molds are adjusted to deliver about 560 r in twenty-four hours, and a total dosage of 1,400 to 2,000 r, extended over a period of three or four days, is delivered to the keloid site. The dosage is adjusted to the probable radiosensitivity of the individual keloid, age of the patient and of the keloid, its extent and elevation above the surrounding skin.

Of 117 cases treated during the years 1933-42, 57 per cent have shown very satisfactory regression, 32 per cent good regression, 8 per cent some regression, and 1 per cent no regression. The pain characteristic of some types of keloid disappeared in practically all cases. In no instance was there a tendency to recurrence after radium treatment had caused regression. Conditions for regression are most favorable in growths of less than one year duration and in younger patients.

VICTOR KREMENS M D

### NON-NEOPLASTIC DISEASE

#### Conductive Deafness and Its Relation to Lymphoid Hyperplasia of the Nasopharynx Benefits from X-Ray Therapy Edward B D Neuhauser and Charles F Ferguson M Clin North America 28 1251-1258, September 1945

Since 1939, 38 patients with conductive deafness have been treated by roentgen radiation at the Chil-

dren's Hospital, Boston, but only 16 have been adequately followed. In 2 instances the response was not satisfactory: one patient had nerve deafness, and treatment was advised only with a vague hope for improvement, the other was a psychoneurotic with complaints of deafness which could never be evaluated. The remaining 14 patients all showed some improvement, and in 12 the response was excellent.

After the diagnosis of conductive deafness due to hyperplastic lymphoid tissue in the nasopharynx has been established, a decision as to the use of surgery or radiation must be made. If there is considerable adenoid tissue it is usually best to remove it surgically. If this has already been done and any secondary hypertrophic tissue is present in or about the eustachian orifices where curettage would be impossible or dangerous because of the possibility of producing stenosis of the orifices, radiation is advisable. It does not appear material whether radium, radon, or roentgen radiation is employed, so long as treatment is complete. The authors recommend roentgen rays because of the simplicity of treatment and its general availability.

When the roentgen treatment of hyperplastic lymphoid tissue was first begun at the Children's Hospital, there was considerable variation in the amount of radiation administered and in the number of treatments given. Now 800 r measured in air is considered sufficient to restore the patency of the eustachian orifices. It is customary to treat through two lateral ports sufficiently large to cover the nasopharynx,  $6 \times 8$  cm is usually adequate. At one sitting 200 r is given through each lateral port (200 kv, 10 ma, 50 cm. TSD, 1.0 mm Al, and 0.5 Cu filtration, with a half value layer of 1.05 mm Cu). One week later a similar treatment is given and the patient is asked to return in six weeks for re-evaluation and a recording by the audiometer.

#### Roentgen Irradiation in the Treatment of Marie-Strümpell Disease (Ankylosing Spondylarthritis) Analysis of 160 Cases James E Hemphill and Robert J Reeves Am J Roentgenol 54 282-289, September 1945

Marie-Strümpell disease is a chronic systemic disease of unknown etiology characterized by inflammatory changes in the synovial membrane and periarthral structures of the sacroiliac and spinal joints, with remissions and exacerbations of systemic and local manifestations. The disease appears to be a clinical entity. The blood sedimentation rate is always elevated and is a guide in follow-up. The disease characteristically begins in the sacroiliac joints and extends upward. Fibrous and bony ankylosis follow a gradual destruction of the joint cartilage. Most cases occur between the ages of twenty and forty-five. Pain and stiffness are early symptoms and are worse in the morning. Paravertebral muscle spasm is closely associated with the pain and stiffness.

Early in the disease the roentgenogram made obliquely at a 45-degree angle may show changes about the articular facets of the vertebrae. Usually the earliest detected changes are in the sacroiliac joints. Calcification of the ligaments producing bridging of the intervertebral disks with ankylosis of the spine, occurs in the final stage of the disease.

The earlier correct diagnosis can be made and proper orthopedic and roentgen treatment instituted the better the prognosis. The orthopedic treatment is most

important, and satisfactory results cannot be expected if roentgen therapy is used alone. The authors' series numbers 160 cases, 86 per cent of the patients were males, 94 per cent were white. The roentgen therapy factors used were 200 kv, 30 to 50 cm distance, 0.5 mm Cu plus 1.0 mm Al, 8 to 25 ma. Elongated fields over the spinal column were treated, and the lateral spinal ligaments were included in the beam. A roughly triangular field was used over the lumbosacral and sacroiliac joints. A total dose of 450 r to 600 r (in air) per field was given, 150 r to each field daily or every other day. The series was repeated in six to eight weeks if necessary. In 78 per cent of those treated one series was given, in 17 per cent two series, and in 5 per cent three series. Seventy-six per cent of the patients were improved by the treatment. Thirteen patients who were bedridden and unable to work returned to gainful occupation. Seventy-two per cent of the treated patients showed a reduction of sedimentation rates after therapy. The main effects of roentgen therapy are reduction of pain, stiffness, and paravertebral muscle spasm. This allows orthopedic correction of the otherwise inevitable deformities, and the authors feel that this is one of the chief values of roentgen therapy.

The pathological granulations of Marie-Strümpell disease are similar to the vascular granulations of other inflammatory reactions known to be radiosensitive. Arrest of the production of the granulating pannus is not too much to hope for. This may be the mechanism of roentgen reaction. To accomplish this, the treatment must be instituted early.

CLARENCE E. WEAVER, M.D.

**Pruritus Ani. A Clinical Study.** Arthur L. Shapiro and Stephen Rothman. *Gastroenterology* 5: 155-168, September 1945.

A study of 70 patients with pruritus ani revealed none of the commonly listed etiologic factors. Neurodermatitis was present in 55.7 per cent of the patients, including those with perianal lichenification. Treatment based on elimination of the use of toilet paper and substitution of a superfatted soap sitz bath, with auxiliary use of phenobarbital, local application of ointments or lotions, and minimum doses of x-radiation was successful in 93 per cent of the 58 patients on whom a follow up could be made.

Thirty-eight out of the 70 patients were given x-ray therapy. The rest did not receive this treatment, either because they had acute inflammatory signs, with the subsidence of which the pruritus disappeared, or because they had received previous irradiation. The authors believe that the only form of pruritus ani in which x-ray therapy is of decisive value and almost necessary for cutting through the vicious circle of itching and scratching is pruritus ani with lichenification. Even in this form, application of crude coal tar ointments can fairly well be substituted for x-rays.

The effect of the irradiation is not directly proportional to the quantity of x-rays given, and small doses of soft radiation are more beneficial than larger doses of more penetrating rays. In this series single doses of 41 to 82 r (corresponding to 1/8 to 1/4 of 1 skin unit) were given, at 80 kv p, h.v. 1.05 mm Cu, without filter. The field of exposure was smaller than 4 cm in diameter and thus back-scatter could be ignored. This treatment was repeated after a two weeks inter-

val, exceptionally after one week. The average total number of irradiations was three. In cases which responded well, no further irradiation was needed, in the others continuation of the treatment would have been useless.

**Short Wave Radiations. Mechanism of the Anti-Inflammatory Effect.** Lewis G. Jacobs. *California & West Med* 63: 127-130, September 1945.

It is the opinion of the author that theories attributing the beneficial action of x-rays in inflammatory lesions to the effect on the lymphocytes, the blood stream, or the infecting microorganisms do not offer a satisfactory explanation. He agrees with Borak that vascular effects play an important role. Recently that writer (*Radiology* 42: 249, 1944) pointed out that x-ray causes dilatation of the capillaries and constriction of the arterioles. This tends to decrease the inflammation by increasing the transudation of antibodies, leukocytes, and lymphocytes, and reduces the heat and swelling. In addition, small doses of radiation have a direct effect on the permeability of the cell membrane, there is increased cell streaming, which is thought to be due to liquefaction of protoplasm, cell metabolism is increased and a reversal of the albumin-globulin ratio is effected.

In order to treat inflammations successfully, it is advisable to use a dose of 50 to 100 r on alternate days (total dose not to exceed 300 r in acute cases and 600 r in chronic cases). Low voltage and light filtration are preferred, except in chronic lesions such as tuberculous adenitis, where an intermediate voltage (140 kv p) is better.

Irradiation therapy is effective against most inflammatory lesions and the results, in the hands of an experienced therapist, are good. Treatment must be individualized, however, the total dosage, kilovoltage, and filtration being suited to the case in hand.

MAURICE D. SACHS, M.D.

## TECHNIC AND DOSAGE

**Contact Radiotherapy. Dosimetry and Distribution of Radiation in the Tissues.** Lucien Mallet. *J. de radiol. et d'électrol.* 26: 9-11, 1944-45.

All types of contact therapy apparatus follow essentially that of Chaoul, using a very long wave length, a filter of about 0.2 mm nickel, and a kilovoltage of about 60. The average skin-target distance is about 3 mm. The Philips tube is described by the author. Here the distance is about 18 mm, the tube is mobile and can be directed manually during treatment. The author made his own determinations as to safety of operation, from the standpoint of stray radiation, and determined that the manufacturer's claims are borne out in this respect. The homogeneity of radiation was also found to be as represented. The dose delivered at working distance would appear to be, after calculations have been corrected, about 7,259 r/m. The depth dose estimations are about as follows: at 5 mm, 40 per cent, at 1 cm, 20 per cent, at 2 cm, 7 per cent. Dosages with aluminum filters added are also given.

After the discussion of the physics involved, a number of case histories are appended, detailing treatment and results, which were considered very good in most well chosen cases of localized malignant skin lesions.

PERCY J. DELANO, M.D.



**A Note on the Effect of Spraying "Contact" Therapy Applicators with Aluminium** W J Meredith Brit J Radiol 18 297-298, September 1945

The undesirable secondary radiation arising from a "contact" applicator may be removed by spraying it with aluminium and covering the tube window with an aluminium plate. A sprayed coating 1/100 inch thick and a filter 0.1 mm thick on the window will cut down the scattered radiation approximately 85 per cent and the primary beam about 5 per cent.

SIDNEY J HAWLEY, M D

**Intensity Variations in the Field of Irradiation** Viggo E Thyssen Acta radiol 26 353-360, June 30, 1945 (In English)

After a brief mention of the literature, the author gives several practical examples of how the intensities in a field of irradiation may be determined, and compares the obtained results with theoretical values.

Over a wooden frame, 25 X 25 cm, a washed roentgen film was stretched and upon this was traced a suitable system of dividing lines. Along these lines small condenser chambers (condimeter, external diameter 10 mm) built on Sievert's principle, with a capacity of 7 r were distributed, so that the entire beam of the tube was mapped out. Back-scatter was avoided by placing the frame 50 cm above the floor on an ordinary laboratory stand. The tubes used showed an even decrease in intensity toward the periphery of the field, with an increasing rate of decrease with greater distance from the middle. A composite curve was constructed from the isodose curves obtained with five different tubes. It was found that the periphery of the field gets roughly 50 per cent of the intensity in the center. At a distance of 8 cm from the center of the field the decrease should theoretically be 5 per cent but was found to be 10 per cent. At a distance of 10 cm the theoretical and actual figures are, respectively, 7 and 20 per cent.

A number of tubes which had seen considerable service produced isodoses which were found to deviate markedly from the normal. Photographs taken with a pin hole camera showed the focus, in each case to be asymmetric. These photographs, when compared with the corresponding isodose curves, give a good correlation of the asymmetric radiation.

The author suggests that, especially with old tubes routine measurement of dose should be supplemented with photography with a pin-hole camera and perhaps with measuring of the distribution of the intensity variations in a given field.

VICTOR KREMENS, M D

**Physical, Biochemical and Therapeutic Aspects of Volume Dose Symposium** J R Clarkson, J W Boag, Barbara Holmes, and F Ellis Brit J Radiol 18 233-246, August 1945

In introducing this symposium Clarkson points out that the total energy absorbed in the body during irradiation is a quantity of great clinical and physical importance. The unit of 'integral dose' suggested by Mayneord in 1940 is the gram-roentgen, which is the energy conversion when 1 r is delivered to 1 gm of air.

This is approximately 85 ergs. The megagram-roentgen (1,000,000 gram roentgens) is approximately equivalent to 2 calories.

Experimental studies on a phantom constructed to resemble the human body show that the integral dose varies greatly with the quality of the radiation. This is significant in connection with questions of protection against stray radiation. A worker with high voltage therapy equipment may receive five times as much energy for an equally measured stray radiation dose as one using diagnostic equipment.

Studies using a 6 X 15 cm field, h v 1 3.7 mm. Cu, and 80 cm focal skin distance, over the center of the trunk show that about 30 per cent of the energy absorbed occurs in parts of the body receiving less than 10 per cent of the dose at the center of the field on the surface. It was also found that the energy absorbed was 50 per cent greater when a limiting diaphragm of 3.2 mm of lead was used as compared with one of 11 mm. thickness. Not only was the dose "outside the beam" increased but the shape of the dose contours was modified by scatter from the outside.

Boag reports additional studies showing that the amount absorbed at 2 mm and 4 mm Cu h v 1 depends primarily on the area and location of the fields, and to a less extent on the focal-skin distance, the size of the patient, and the half-value layer.

The biochemical aspects are discussed by Holmes while Ellis takes up the correlation of biological effects with the volume dose. He concludes that the chief value of the volume dose at present is in evaluating principles of treatment and protection on physical grounds rather than as a practical guide to biological effects. "The conception of volume dose as a means of enlarging our knowledge and understanding of the principles of radiotherapy has been of great value, and it provides a yardstick for measuring many future developments. In connection with individual patients it is less an aid to treatment at present than a means of collecting scientific knowledge, but when more is known of the effect of radiation I foresee an added usefulness in the scientific field which might possibly be translated into terms of everyday treatment."

Curves are given from which an estimation of the integral dose may be made with reasonable accuracy.

SIDNEY J HAWLEY, M D

**A Quantitative Analysis of the Effect of Gamma Radiation on Malignant Cells in Vitro and in Vivo.** I Lasnitzki Brit J Radiol 18 214-220, July 1945

For this study of the effect of gamma radiation on tumor cells the material used was transplantable mouse adenocarcinoma 63. The dose in both *in vivo* and *in vitro* experiments was 198 r at a rate of 11 r per minute. The effect of the radiation was measured by counts of mitotic cells and degenerating cells. In both types of experiment the effect on inhibition of mitosis and on the occurrence of cell degeneration was qualitatively and quantitatively similar. The effect upon cells which were already in division was more marked *in vivo* as was recovery from the effects of the irradiation.

SIDNEY J HAWLEY, M D

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## Gas Formation in Abdominal Abscesses A Roentgen Study<sup>1</sup>

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THE EARLY diagnosis of abdominal abscesses is of considerable clinical importance. Roentgenologic examination is not only valuable in their diagnosis and localization but also in the differentiation from tumors and hematomas.

The roentgenologic features of abdominal abscesses have been described in a small number of excellent studies and will not be the subject of this discussion (1, 2, 3). Generally, the roentgenologic signs depend to a great extent upon the localization of the abscess. Thus, an intraperitoneal abscess may be demonstrable as a space-occupying process displacing the intestinal loops, which usually reveal some degree of ileus in the neighborhood of such an infection. A roentgenologic sign of prime importance is the obliteration of the intermuscular and subperitoneal fat layers of the adjacent abdominal wall, which may be attributed to edema associated with the inflammatory condition.

Abscesses invading or originating in the retroperitoneal space may cause blurring or obliteration of the psoas shadows and frequently lead to swelling of the soft tissues of the flank, which may be demonstrated to advantage on roentgen examination. The changes in the position and motility of the diaphragm associated

with subphrenic, intraperitoneal, and retroperitoneal abscesses are generally known.

These signs, in conjunction with clinical findings, will in many instances be sufficient to establish a diagnosis. Not infrequently, however, the roentgenologic evidence mentioned above may be equivocal or difficult to demonstrate. In children and old people, the subperitoneal and intermuscular fat layers of the abdominal wall may be poorly defined, and marked intestinal distention may obscure the detail of the psoas shadows. On the other hand, large retroperitoneal tumors and hematomas may distort the structures of the abdominal wall and make their fat layers indistinct. Thus, there remain cases in which the differential diagnosis between an inflammatory mass and tumor or hematoma is difficult. Any additional roentgenologic sign, therefore, will be of definite value.

It has been shown by Laurell (1, 2) that abscesses may occasionally contain gas vesicles visible roentgenologically. The roentgen demonstration of gas production in infections caused by *C. welchii* and related organisms is now generally recognized as a valuable diagnostic procedure (4). It is surprising, therefore, that in the roentgenologic literature little attention is given to gas formation in infections which

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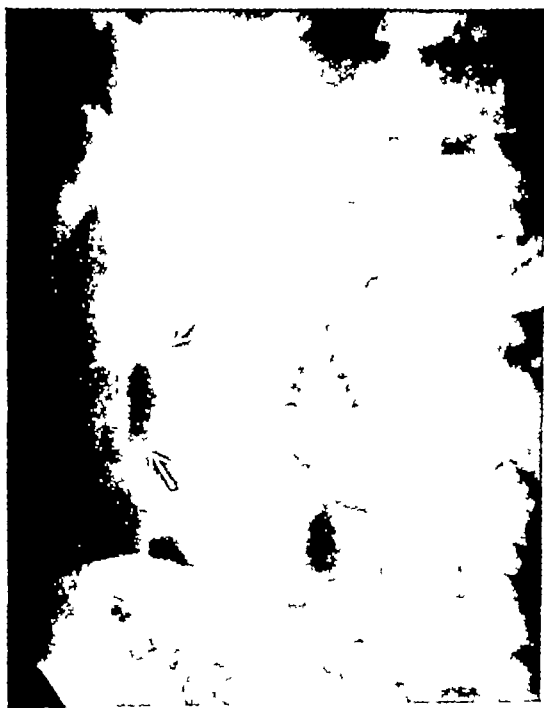


Fig 1 Case I Gas formation in large subhepatic abscess

are caused by other organisms, such as colon bacilli and anaerobic streptococci. Subphrenic abscess is the only condition in which gas formation, due to the colon bacillus, is commonly known to occur (5). There is no doubt, however, that in many subphrenic abscesses the observed gas represents air which has penetrated into the abscess cavity by way of a fistula from the lungs or gastro-intestinal tract. Gillies (6) has observed that in diabetic patients gas formation may occur in retroperitoneal infection due to *E. coli*.

Recently we observed a series of abdominal intraperitoneal and extraperitoneal abscesses in which gas formation was a conspicuous feature. The purpose of this paper is to emphasize that gas formation in abscesses is a valuable roentgenologic sign and may contribute largely to a correct diagnosis.

Following are brief descriptions of 6 selected cases illustrating gas formation in intraperitoneal and retroperitoneal abscesses. The etiologic agents of these infections will be discussed.

## CASE REPORTS

**CASE I Intraperitoneal Abdominal Abscess** C. S., a 35 year old colored male, was admitted to Grady Hospital because of a large, non tender mass in the right side of the abdomen. He had been well until eight months prior to admission, when he had an episode of hematemesis and melena. There had been no other symptoms until the day of admission when the patient was seized with a sharp pain in the right lower abdomen which radiated into the upper abdomen and umbilical region.

The temperature on admission was 99.6° F and the pulse rate was 120. A large mass, measuring about 15 cm in diameter, extended from the rib margin downward into the flank. This mass was firm, non-tender, and had a smooth surface. The spleen and kidneys were not palpated. The blood count showed a moderate leukocytosis but was otherwise not remarkable. There were no positive urinary findings.

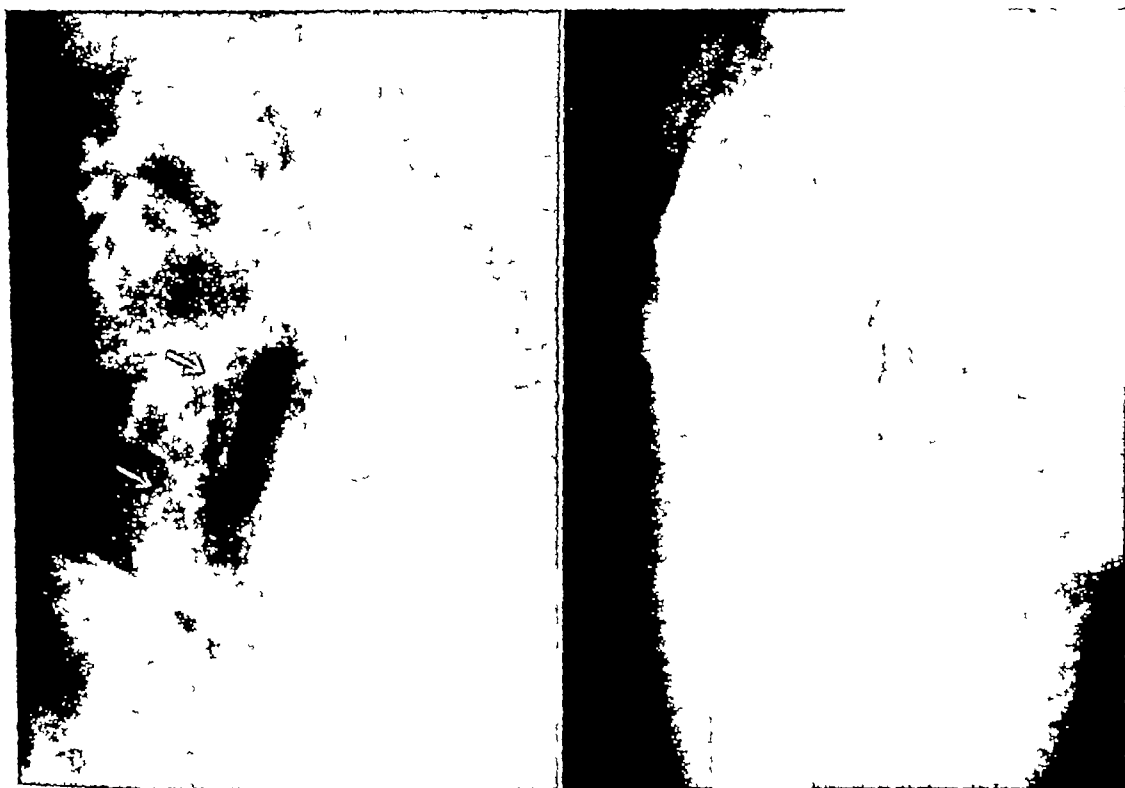
The patient was examined by several members of the staff, who expressed the opinion that the mass represented an intraperitoneal or retroperitoneal tumor.

During the hospital stay the fever ranged between 99.6 and 102.4° F. The patient felt subjectively well and did not complain of pain, though the mass gradually increased in size.

**Roentgenologic Examination** A film study of the abdomen revealed a large mass throughout the right side, distorting the structures of the abdominal wall without obliterating the fat layers. A retrograde pyelogram made shortly after admission demonstrated that the right kidney was essentially normal but was displaced upward and that the right ureter was deviated toward the spine. A barium enema study several days after admission showed the hepatic flexure markedly depressed by the large tumor. At this time several gas vesicles which had not been present earlier appeared in the center of the mass. A motility series revealed that there were no intestinal loops in the region of the gas formation nor was any fistula present (Fig 1). On the basis of this information, it was concluded that the mass represented an abscess with gas formation.

**Operative Findings** The patient was operated on ten days after hospital admission and a large intraperitoneal abscess was encountered at the inferior aspect of the liver. Foul-smelling pus, under considerable tension, was evacuated from this abscess. Aerobic and anaerobic cultures revealed anaerobic streptococci but no gram-positive bacilli. A subsequent gastro-intestinal examination showed a definite deformity of the duodenal cap and it was thought probable that the abscess originated from a perforated duodenal ulcer. Recovery was uneventful.

**Comment** A 35-year-old male had a large, non-tender mass in the right side of



Figs 2 and 3 Case II Retroperitoneal abscess Fig 2 (left) shows extensive gas formation within the psoas sheath Fig 3 (right) shows extension of the gas formation into the soft tissues surrounding the right hip joint

the abdomen, believed clinically to represent a retroperitoneal or intraperitoneal tumor. After hospital admission the mass gradually increased in size and the development of gas was noted in its center. This was the deciding factor in establishing the diagnosis of abscess formation. Anaerobic streptococci were cultured from the abscess, which was found to be localized at the inferior aspect of the liver.

**CASE II Retroperitoneal Infection M G P**, a 57-year-old Negress, was admitted to Grady Hospital because of abdominal pain, fever, weakness, and slight mental confusion. In preceding years she had suffered occasionally from pain in the right lower abdominal quadrant, which had become constant during the last three weeks.

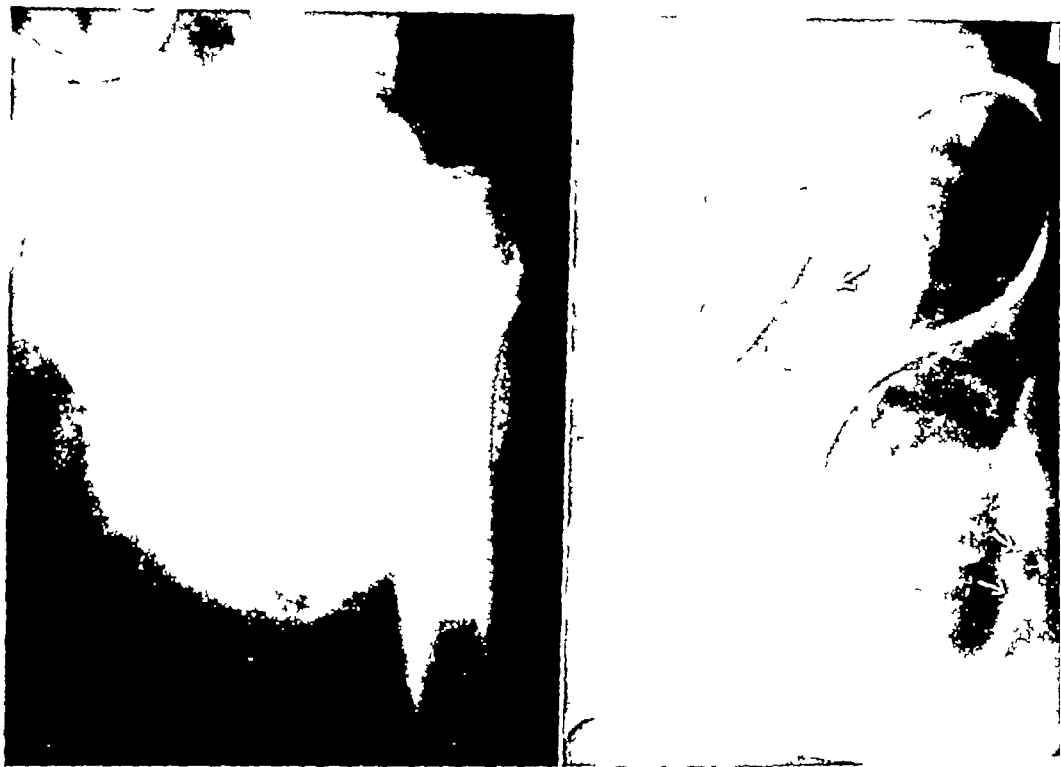
The temperature on admission was 101.0° F and the pulse rate was 120. The blood pressure was 144/88. There were no remarkable chest findings. A diffuse mass, measuring several centimeters in diameter, was felt in the right lower quadrant of the abdomen. The pelvic examination revealed an erosion of the cervix, which was displaced to the right side. Considerable induration was noticed in the region of the right adnexa.

The urine examination revealed 4-plus sugar, 2-plus acetone, and a trace of protein. The blood sugar one day after admission was 274 mg per cent. There was no anemia, but there was a leukocytosis of 30,000 with 86 per cent polymorphonuclears.

**Röntgenologic Examination** Roentgen studies showed considerable edema of the fat layers of the right lower abdominal wall, and the right psoas shadow was poorly outlined. Though the loops of the small and large intestine were greatly distended, a group of small gas vesicles was clearly recognized in the region of the right psoas muscle (Fig 2). These gas shadows were arranged in a peculiar pattern which did not seem to follow the distribution of intestinal loops. On account of this finding, a diagnosis of retroperitoneal abscess formation with gas formation was made.

In spite of all efforts to regulate the diabetes and combat infection and acidosis, the patient grew steadily worse. On subsequent roentgen examination the gas formation in the retroperitoneal space was seen to be more pronounced and to extend downward to the soft tissues of the thigh, where definite crepitation could be felt (Fig 3). A pyelogram did not disclose any remarkable findings.

**Operative Findings** On the fifth hospital day, the retroperitoneal space was surgically explored. The psoas sheath was opened and a moderate amount of dark brownish pus was found in the necrotic muscle.



Figs 4 and 5 Case III Fig 4 (left) shows numerous gas shadows in the soft tissues of the thigh, which was tympanic on percussion. Numerous small gas vesicles in the region of the psoas muscle are seen in Fig 5. There is gas formation at the outer aspect of the descending colon, apparently localized in the retroperitoneal space.

tissue. The infectious process extended upward to the kidney and downward to the iliac fossa. The patient did not improve after operation and died on the ninth hospital day.

Culture of the pus revealed only *E. coli*. No gram-positive bacilli were obtained on anaerobic cultures.

**Comment** A 57-year-old colored female with diabetes had an extensive retroperitoneal infection extending into the soft tissues of the thigh. The characteristic finding in this case was gas formation, which by aerobic and anaerobic cultures was found to be due to an *E. coli* infection. The gas formation was readily recognized on roentgenologic examination, which made an early diagnosis possible. The origin of the retroperitoneal infection remained uncertain.

**CASE III Retroperitoneal Infection** A W M, a 57-year-old white male, was admitted to the hospital because of fever and pain in the left lower quadrant of the abdomen. He gave a history of repeated left renal colic and pyelonephritis, for which

he had been admitted to the hospital on previous occasions. On his last hospital admission a left hydronephrosis and ureteral stricture were recognized on pyelographic examination. The patient was treated in the outpatient department with sulfonamides and two ureteral dilations. Following the second dilatation, he returned to the hospital complaining of slight fever and pain in the left lower abdomen.

There was moderate tenderness in the left lower quadrant, and considerable distention of the intestine was evident on physical examination. The left ureter was again catheterized and urine was obtained from the left kidney. About two weeks after hospital admission, a large swelling appeared at the inner aspect of the thigh, which was tympanic on percussion.

**Roentgenologic Examination** Roentgen examination showed numerous large gas bubbles in the soft tissues of the thigh, extending upward into the groin (Fig 4). There were also many small gas vesicles in the region of the psoas shadow and left flank lateral to the descending colon (Fig 5). It was concluded that the gas formation was due to an extensive retroperitoneal infection.

**Operative Findings** The swelling in the thigh was aspirated and a large amount of gas with some pus was obtained. Through an incision in the left flank,

a considerable amount of pus and gas was evacuated from the retroperitoneal space. The patient did not improve after this operation and died five days later. The cultures from the aspirated material were overgrown by *B. proteus*.

**Comment** In a 57-year-old man, suffering from hydronephrosis and ureteral stricture, there developed an extensive retroperitoneal infection with gas formation. This process extended into the soft tissues of the thigh, where gas formation was most pronounced. It was believed that the retroperitoneal infection was most likely due to trauma of the left ureter. The gas formation was demonstrated roentgenologically without difficulty and was a valuable sign in the diagnosis and localization of the infection. The cultures were overgrown by *B. proteus*. This makes it impossible definitely to rule out an infection due to *Cl. welchii* and related organisms. Clinically, this case resembled to a certain extent Case II.

**CASE IV Retroperitoneal Infection** L. P., a 42-year-old colored male, was admitted to the hospital with a gunshot wound of the abdomen. An x-ray examination on admission revealed a bullet close to the right wing of the sacrum. The right psoas shadow was obliterated but the right kidney shadow was well outlined.

The heart and lungs were normal on physical examination. A puncture wound was found in the right upper quadrant of the abdomen, which was rigid and tender on palpation. Urinalysis of a centrifuged specimen disclosed 5-10 red blood cells per high power field but was otherwise not remarkable.

An exploratory abdominal operation revealed three perforations of the small intestine, several perforations of the mesentery, and a tear of the posterior parietal peritoneum. The intestinal perforations were repaired, and a retroperitoneal hematoma was evacuated. Several days after operation, a hectic fever developed and a mass was palpable in the right flank.

**Roentgenologic Examination** An intravenous pyelogram outlined the right kidney pelvis and calices, which were moderately dilated. The right ureter, which was well demonstrated throughout its upper portion, was displaced anteriorly and to the left. A large mass occupied the entire right half of the abdomen, obliterating the psoas shadow and the fat layers of the right abdominal wall. Numerous small gas vesicles were scattered throughout this mass, which was considered to represent an infected hematoma or urinary extravasation with infection (Fig 6).



Fig 6 Case IV Numerous small gas shadows localized in a large soft tissue mass in the right retroperitoneal space. Right hydronephrosis. Bullet overlying right sacrum.

**Operative Findings** The retroperitoneal space was again explored one week after admission, and about 1,500 cc of foul-smelling urine was evacuated. This was believed to be the result of extravasation from a severed right ureter.

After the second operation, the patient failed to improve. Repeated roentgenologic examination of the urinary tract showed that the large mass in the flank had changed very little in size and that numerous gas bubbles remained in this area. A right nephrectomy was performed, and about 500 cc of frothy yellowish pus were evacuated from an abscess at the posterior aspect of the right kidney.

Aerobic and anaerobic cultures at operation contained *E. coli*. No clostridia were grown.

The patient made an uneventful recovery.

**Comment** After a gunshot wound of the abdomen, a retroperitoneal urinary extravasation occurred in a 42-year-old male. On roentgenologic examination it was possible to predict the presence of infection in the retroperitoneal mass by the conspicuous gas formation. Persistence of the gas formation after draining of extravasated urine disclosed a large abscess in the retrorenal space. *E. coli* was believed to be the pathogenic organism.



Fig 7 Case V Gas formation in large abdominal wall abscess Note resemblance to herniated intestinal loop

**CASE V Abdominal Wall Abscess** S B, a 60-year old colored female, was admitted because of fever and a painful mass in the right upper abdomen. She had discovered this mass two weeks before admission and had noticed that it gradually became larger in size. There was no history of gastrointestinal symptoms.

The patient, who was markedly obese, had moderate fever but was in no acute distress. In the right side of the abdomen was a large superficial mass the size of a grapefruit, very tender on palpation. No other masses were palpable.

**Röntgenologic Examination** The fat layer of the abdominal wall was greatly increased in width. In the region of the superficial mass the fat layer was indistinct and was replaced by a diffuse swelling containing several large gas bubbles (Fig 7). This gas formation suggested an abscess, though the possibility of a herniated loop of small gut could not be ruled out.

**Operative Findings** Surgical exploration of the abdomen revealed a large abscess in the subcutaneous fat layer of the abdomen which communicated with another abscess localized below the fascia. Careful exploration of the abscess cavities disclosed no herniated intestinal loops or fistulae. Upon opening the abscess, a large amount of gas escaped

from the incision. Anaerobic streptococci were found on cultures, no clostridia were obtained. The patient made an uneventful recovery.

**Comment** A 60-year-old female had a large abscess of the abdominal wall, the etiology of which remained unknown. On roentgenologic examination a large amount of gas was demonstrated in the abdominal abscess. Anaerobic streptococci were believed to be the causative organisms in the development of infection and gas formation.

**CASE VI Abdominal Wall Abscess and Intra Abdominal Abscess** L M, a 39-year old colored female, was admitted to Grady Hospital because of abdominal pain and a mass in the right lower quadrant of the abdomen. Three weeks before admission she suddenly became ill with cramping pain, nausea, and vomiting. These symptoms subsided rapidly, but some aching remained throughout the lower abdomen. About two weeks before admission a mass was noticed in the right lower abdomen, which gradually increased in size.

The temperature on admission was 99.2° F. A large, bulging, firm, tender mass, about 8 cm in diameter, was palpated in the right lower quadrant of the abdomen. The white blood count showed a moderate leukocytosis. Urinalysis was not remarkable.

**Röntgenologic Examination** An anterior-posterior film of the abdomen disclosed a poorly circumscribed mass in the right lower abdomen, displacing distended loops of small and large intestine. The subperitoneal and intermuscular fat layers of both flanks were well outlined and not distorted. An oblique view of the abdomen revealed that the bulging mass was located superficially and contained a small number of gas vesicles (Fig 8). The subperitoneal fat layers in the region of the abscess were obliterated.

**Operative Findings** The abdominal mass was incised and about 300 cc of foul-smelling pus were obtained. Exploration of the abscess cavity, which was located in the abdominal wall, disclosed a perforation in the posterior rectal sheath connecting with a large intraperitoneal abscess, which was likewise drained.

Recovery was uneventful.

**Comment** A 39-year-old female had an abdominal-wall abscess which was most likely the result of a perforated appendiceal abscess. A film study in the anterior-posterior view failed to reveal obliteration of the peritoneal fat layers of the flank. In an oblique view superficial localization

of the abscess was demonstrated. Several gas vesicles were localized within the abscess. Unfortunately, bacteriologic studies were not done in this case.

#### DISCUSSION

*Bacteriologic Considerations* There is no doubt that most gas infections in man are caused by members of the group of spore-bearing gram-positive rods, such as *Cl welchii*. Gas formation due to other organisms, however, especially in conjunction with intraperitoneal and extraperitoneal infections, seems more common than is generally appreciated.

Though infection and gas formation caused by *E coli* and related organisms were studied at a time when roentgenologic examinations were not yet available, little attention has been paid to this subject in recent years. Thus, the older literature contains reports of *E coli* infections in conjunction with gaseous gangrene of the foot (7), retroperitoneal phlegmon (8), and paravesical infection (9). More recently Olsson (10) observed roentgenologically gas formation due to *E coli* infection in the kidney pelvis and renal parenchyma. In emphysematous infection of the urinary bladder *E coli* may be encountered as a causative organism (11). In a case of emphysematous gastritis *A aerogenes* and *B proteus* were believed to have taken part in the infection and gas formation in the stomach wall (12).

Extensive gas formation in retroperitoneal infections due to *E coli* was reported by Gillies (6) in diabetic patients. The high dextrose level of the tissue fluids in diabetes apparently facilitates both infection and gas formation by *E coli* and related organisms. Hitschmann and Lindenthal (13) had previously made a similar observation and postulated that gas formation due to *E coli* in human tissue would occur only in the presence of diabetes. This conception was refuted by numerous clinical and experimental observations (8, 9, 14, 16) in which gas formation due to *E coli* was demonstrated in non-diabetic individuals.



Fig 8 Case VI. Small group of gas vesicles in abdominal wall abscess.

It is not commonly known that the group of anaerobic streptococci may also form gas in human tissues. Colebrook and Hare (15) demonstrated that anaerobic streptococci were abundant gas formers on suitable culture media. Marwedel and Wehrsig (16) in a clinical observation described two cases of gas infection of the lower extremities due to anaerobic streptococci. These authors state that anaerobic streptococci without association with other organisms, and in the absence of a preceding suppuration or necrosis, may produce gas gangrene similar to that due to *Cl welchii* and related organisms. Recently MacLennan (17) made similar observations and asserted that streptococci may infect muscle and produce a condition which is likely to be mistaken for gas gangrene.

From these observations it may be seen that gas formation in infectious processes



by no means an exclusive manifestation of *Cl welchii* or other spore-bearing gram-positive bacilli. As illustrated in our cases, conspicuous gas formation may be demonstrated on roentgenologic examination in infections due to other organisms, such as anaerobic streptococci, *E coli*, and related bacteria. It seems important for the clinician and roentgenologist to be familiar with this fact in view of the proper classification, treatment, and prognosis of infections with gas formation.

**Roentgenologic Diagnosis** The roentgenologic diagnosis of gas formation is dependent to a great extent upon the localization of the inflammatory process. Gas formation in the retroperitoneal space may have a characteristic appearance. The gas vesicles may occupy the fascial planes, lining the borders of the retroperitoneal structures, as the kidneys, adrenals, and spleen groups. Gas vesicles localized within the psoas muscles are usually arranged in long rows parallel to the course of the muscle fibers. This also holds true in infections which spread from the retroperitoneal space into the soft tissues of the thighs and groin, where the gas vesicles usually follow the course of fascial planes and muscle bundles.

Gas formation in intraperitoneal abscesses is recognized with more difficulty. A differential diagnosis between bacterial gas formation in abscesses and gas utilized in intestinal lumina will in many instances be facilitated by the observation that the gas bubbles in the abscess are in an area which is not usually occupied by intestinal loops. For example, in Case III (Fig. 5), gas vesicles were seen in the lateral aspect of the descending colon, where small intestinal loops are not usually seen. Also, it may be possible in many instances to identify intestinal loops by their characteristic segmentation and mesosal pattern. Administration of contrast medium by mouth will outline the entire gastro-intestinal tract and help to point out the presence of a fistula. It may be exceedingly difficult to differentiate between gas vesicles localized in an abscess

of the abdominal wall and intestinal loops herniated into the abdominal wall. The intestinal loops are often sharply outlined and may maintain some of their characteristic pattern, whereas gas formation in an abscess is characterized by numerous small vesicles which are frequently arranged in clusters.

Small gas shadows in abscesses may be easily overlooked, but an examiner who is aware of this phenomenon will recognize them with less difficulty and confirm their presence by repeated examinations in oblique, recumbent, and upright views and by stereoscopic studies. The observation of gas formation is more helpful than is generally appreciated, and every effort should be made to utilize this phenomenon in roentgenologic diagnosis.

#### SUMMARY AND CONCLUSIONS

1 Gas formation in abdominal abscesses does not necessarily indicate the presence of an infection due to *Cl welchii* and related bacteria but may be caused by a variety of organisms.

2 In a small series of cases *E coli*, *B proteus*, and anaerobic streptococci were found in intraperitoneal, retroperitoneal, and abdominal-wall abscesses.

3 Various roentgenologic signs of abdominal abscesses are briefly discussed, and difficulties in their demonstration and evaluation are mentioned.

4 Gas formation in abscesses is a valuable roentgenologic sign of infection which may be of considerable aid in differentiating them from tumors and hematomas.

5 It is demonstrated that in occasional cases gas formation is the most significant roentgenologic sign of an abdominal abscess. It is suggested that in the interpretation of roentgenograms particular attention be paid to this phenomenon.

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# Lymphoepithelioma<sup>1</sup>

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THE RADIOLOGIST who is called upon to treat squamous-cell carcinoma of the face, mouth, and jaw, often after hopeless metastases are present in the regional lymph nodes, welcomes the occasional radiosensitive tumor arising in this area. The lymphoepithelioma is a neoplasm of this type. Its unpredictable metastases add to its interest and its radiosensitivity serves as a challenge to search out and treat the secondary lesions as they occur. Unfortunately, as is so often true in cases referred to the radiologist, the metastases may be in such a location that no amount of radiation will produce regression. Not infrequently the discovery of the metastases antedates the demonstration of the primary tumor. Its discovery may be not only difficult but impossible.

Not until recent years has primary carcinoma of the nasopharynx been considered of frequent occurrence. In 1904, Laval (31) was able to find only 27 instances of primary carcinoma in this location recorded in the literature. Gatewood (21), in 1916, found 26 more reported cases and added 2 of his own. It was suggested by this authority that the difficulty in distinguishing primary nasopharyngeal carcinoma from sarcoma and endothelioma might perhaps account for the small number of cases on record.

New (36) reported 79 cases of malignant tumor of the nasopharynx, including only epitheliomas and lymphosarcomas, all seen in a six-year period prior to 1922. He concluded that such tumors were much more common than had previously been believed. Ewing (15), in 1929, reported and classified 300 cases of intra-oral cancer. Two hundred were of the tonsil and 100 of the nasopharynx. Gardham (20), in 1929, described a group of nasopharyngeal tu-

mors infiltrating about and into the base of the skull. In his opinion these were endotheliomas. In 1931, New (37) was able to present a series of 246 malignant tumors of the nasopharynx. Dunlap (12), Digby (10), and Green (22) report a high incidence of nasopharyngeal neoplasms in Orientals. In a six-year period of private practice Dunlap saw 16 cases in Chinese patients. The tumors all arose at the nasopharyngeal opening of the eustachian tube and in the tube itself. During this period he saw no lesions of this type in his other private patients, most of whom were Caucasians. He reported most of his cases as transitional-cell carcinomas.

In 1921, Reverchon, Regaud and Coutard (42, 44) were impressed with the radiosensitivity of a group of tumors occurring in the nasopharynx. These tumors had a peculiar cell structure consisting of a close and constant relationship between the epithelial and lymphoid elements. The resemblance to normal lymphoepithelial tissue led the authors to apply the name "lympho-épithéliome" to this group. In the same year Schmincke (46), working independently, reported radiosensitive tumors arising in the same area and showing a similar microscopic picture. Jovin (28), in 1926, published a series of cases from the Radium Institute of Paris, describing the clinical, pathological, and radiosensitive characteristics of the disease. He agreed with opinions previously expressed, that these tumors arise from lymphoepithelium occurring normally in the nasopharynx. The widespread metastases, high degree of malignancy, and susceptibility to radiation were emphasized as the essential clinical features.

Quick and Cutler (39), in 1925 and again in 1927 (40), pointed out that from a group

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of epidermoid carcinomas a few showed a high degree of radiosensitivity and a peculiar histologic structure. These tumors presented transitional-cell characteristics. They were found at the base of the tongue, in the tonsil, or in the eustachian canal. Histologically, they had been variously classified as atypical epidermoid carcinomas, anaplastic carcinomas, embryonal tumors, lymphoepitheliomas, and transitional-cell carcinomas. It was felt that many cases reported as reticulum-cell sarcoma and lymphosarcoma were likely of this cell type. Obviously these authorities were not ready to recognize the lymphoepithelioma as a specific tumor, separate and distinct from transitional-cell carcinoma, which in location and clinical behavior is almost if not entirely identical with the lymphoepithelioma.

Ewing (15), in his masterful discussion of radiosensitive carcinomas in 1929, makes a definite microscopic distinction between the transitional-cell carcinoma and the lymphoepithelioma. Among his 300 cases involving the tonsil and nasopharynx were 15 lymphoepitheliomas and 51 transitional-cell carcinomas. He admitted that he found it impossible always to make a definite differential microscopic diagnosis between the two tumors. In his study of similar cases seen by Lacassagne in the Radium Institute of Paris, he found cases that were called lymphoepithelioma which he would have called transitional-cell carcinoma or schneiderian carcinoma. In more recent years, case reports of this interesting tumor have been recorded by many writers (5, 17, 33, 2, 23, 3, 25, 4, 1, 38, 30, 47, 45, 35, 11). Fitzhugh (18), up to 1938, found 150 cases reported in the literature as lymphoepithelioma and added 5 of his own.

The common location of the primary lymphoepithelioma is the nasopharynx, pharyngeal tonsil, and base of the tongue. One case primary in the parotid has been reported (16). The primary lesion is usually small. It presents on inspection a finely granular surface which early shows no ulceration. It may give the appearance

of having arisen from deeper structures, with fixation secondarily of the mucous membrane over the surface. Quick and Cutler (40) described the lesion as being diffuse, in some instances extending around the pharyngeal ring and involving the mucous membrane of the base of the tongue, tonsils, and posterior pharynx, with superficial ulceration and bilateral cervical adenopathy. In none of our cases was such extensive involvement by the primary tumor seen. Occasionally a very large tonsillar tumor is encountered, extending across the mid-line, interfering with breathing and swallowing. The primary tumor does not tend to bleed and for this reason is often overlooked. Arising in the eustachian canal, as it often does, it may never be found. Enlarged cervical lymph nodes are usually present and may be the first evidence of a malignant tumor.

The microscopic picture has been described fully by such pathologists as Jovin (28), Ewing (15), Cappell (6), and Wahl (50). As a radiologist, I accept their descriptions and quote freely the findings recorded by them. Ewing emphasizes the fact that the histologic structure is not always the same. Jovin describes sheets of large delicate cells, with large vesicular nuclei and indefinite cell borders, infiltrated with leukocytes. In Schmincke's case the cell groups were more broken up. The cell walls were indefinite and the admixture of lymphocytes was so abundant that epithelial cells were identified with difficulty. This process approaches the structure of a lymphosarcoma. Squamous and spindle cells are entirely lacking. Because of the indefinite cell membrane and faint staining, the impression may be gained of a syncytial mass. The cells contain large clear nuclei with a prominent nucleolus, which often shows mitotic figures.

Cappell (6) separates the lymphoepitheliomas into two main groups, the Regaud-Jovin type and the Schmincke type. The former consists of strands of epithelial cells with large pale-staining nuclei and poorly delineated cytoplasm embedded in a stroma more or less rich in

lymphocytes The nuclei are usually round or oval, rather poor in chromatin, and contain one or two nucleoli The outline of the individual cells is indistinct, and no intercellular bridges can be demonstrated In many places the epithelial cells appear in broad sheets, lying in a well formed fibrous stroma, while in other areas they are seen as thin strands penetrating deeply into the tissues of the palate and nasopharynx The individual cells may be closely packed together or may form a loose type of architecture heavily infiltrated by lymphocytes

The second group, to which the name of Schmincke has been applied, consists of irregular anastomosing trabeculae of ill defined cells with large vesicular nuclei In many places the appearance of epithelial columns is lost and the cells become dissociated from one another, giving rise to a mass of loosely packed round, oval, or polyhedral cells In some places these elements form the bulk of the tumor, but in other parts they are separated by dense lymphocytic infiltration which tends to isolate them from one another and renders recognition of individual cells difficult

To the author the difference in the two pictures is slight It seems to me, as I study the descriptions, that the Schmincke type is characterized by greater lymphocytic infiltration than is the Regaud-Jovin type Cappell concludes that probably the Regaud type arises from the schneiderian membrane It has not yet been decided whether or not, when it arises in the tonsil region, it is made up of hyperplastic tonsillar reticulum or represents a permeation of the tonsil by neoplastic cells

Harvey, Dawson, and Innes (24) point to the fact that lymphocytic deposits in the mucosa and submucosa are characteristic of the embryonal entodermal tract and persist to some extent in the adult When an epithelioma arises in such a structure or penetrates such a tissue, it seems only natural that the lymphoid tissue should still retain its original relation to the epithelium These writers prefer to classify all of the tumors which are not of definitely squamous-cell origin as epidermoid or

transitional-cell carcinoma In their opinion, neither architecture nor cytology is sufficiently distinctive to justify a separate classification as lymphoepithelioma

Several theories relating to the origin of this tumor have been advanced The least acceptable, by most pathologists, is the embryonal theory Hoffmann (26), after studying 111 cases reported by 33 observers, concluded that the tumor has a branchiogenous origin and is dependent on congenital anomalies It is assumed that islets of germinal tissue lie dormant for years and begin to grow, due to factors unknown

Quick and Cutler (40) suggest that since transitional epithelium is found at the base of the tongue, in the folds and sinuses of the larynx, in the nares, and in the crypts of the tonsils, it would not be unusual to find tumors of the same cell type arising there They also suggest that these tumors arise from squamous cells which in their growth fail to develop spines, lose their adult characteristics, undergo aplasia, and become changed to an undifferentiated rounded or polyhedral form They then grow diffusely as anaplastic tumors

Regaud (42), Schmincke (46), Jolly (27), Mollier (34), Ewing (14), and others, accept the theory that the epithelium covering the lymphoid deposits of the nasopharynx, especially of the tonsil and base of the tongue, are fundamentally modified by a symbiosis with lymphocytes, and that this tissue should be regarded as a specific tissue, lymphoepithelium This lymphoepithelial tissue was recognized and described by Retterer (43) as early as 1886 It was also discussed by Stohr (48) and Jurisch (29) prior to the description of the tumor by Schmincke and Regaud Origin from this lymphoepithelial tissue seems to be the most popular and to the author the most reasonable theory Its opponents assume that lymphocytes may enter a tumor secondarily It has been shown by Derigs (9), Cutler (41), and others, that bone and visceral metastases present the same cell type, including lymphocytic symbiosis or infiltration, as does the pri-

mary tumor This seems to be a logical argument in favor of a specific tissue origin

#### SYMPTOMS

Trotter (49), in 1911, discussing certain nasopharyngeal tumors which he assumed usually to be endothelioma, but which, because of their manner of metastasis, may have been of the type under discussion, outlined the classical symptoms These include the triad of deafness, neuralgia, and lack of normal excursion of the palate New (36), in 1922, clearly brought to our attention the fact that many symptoms other than a sore throat may be the chief complaint of a patient suffering from a malignant nasopharyngeal tumor He pointed out the fact that the nasopharynx is in close relationship to the eustachian tubes, to the 2d, 3d, 4th, and 6th nerves, the 2d and 3d division of the 5th nerve, the gasserian ganglion, the sella turcica, the jugular foramen, and the 9th, 10th, 11th, and 12th nerves Symptoms indicating involvement of any of these structures should immediately suggest a nasopharyngeal neoplasm This broad field for possible invasion by the tumor suggests that the rhinologist should be called into consultation more often to evaluate deceptive symptoms which may be due to such invasion

Symptoms described by New are as follows (a) pain in the eye with or without diplopia, (b) pain in the ear resembling an acute infection or mastoiditis, (c) trigeminal neuralgia, (d) ptosis of an eyelid, (e) enlargement of cervical lymph nodes Enlargement of the cervical nodes was present in 46 per cent of a later series of 246 cases of malignant nasopharyngeal tumors presented by New (37) In the tumor under discussion enlarged nodes may be the only visible evidence of disease This has led to a diagnosis of primary endothelioma of the lymph nodes in some cases Ewing feels that this is a hazardous diagnosis to make, until all possibility of a primary tumor has been eliminated Ankylosis of the lower jaw due to invasion of the muscles of mastication may make ade-

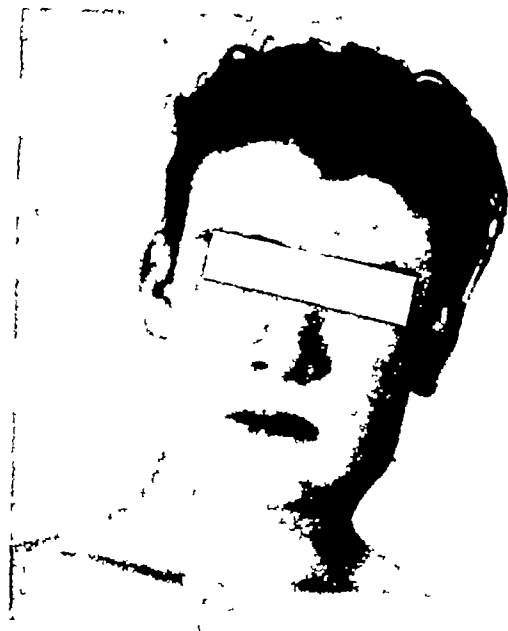
quate examination of the nasopharynx impossible This was true in one of our cases (Case 3) Many authorities (13, 7, 51) have stressed the observations of New Even though lymphoepithelioma is not obvious to the careful examiner, it must be kept in mind when these symptoms are presented

#### TREATMENT

We were prompted to present this subject to radiologists because of the rather slight mention this tumor has received in radiological literature Even though the treatment is recognized as entirely in the hands of the roentgen and radium therapist, the major discussion has appeared in the periodicals of the pathologist and otorhinolaryngologist Crowe and Baylor (8) were among the first to stress the importance of radiation and gave Dr Curtis Burnam credit for treating their nasopharyngeal tumors Quick and Cutler (39) reported the effect of radiation on metastatic squamous-cell carcinoma of the cervical nodes They found that small doses of radiation which had no effect on fully differentiated squamous-cell carcinoma caused rapid and effective regression of the transitional-cell type Martin and Blady (32) presented an excellent summary of radiation therapy procedure

If the tumor is in the tonsillar area, we prefer roentgen treatment to application of radium Through a round portal, 3.5 cm, a dose of 300 r is applied intra-orally every other day On alternate days 300 r are given to the adjacent cervical area, through a 10 × 10-cm portal To the skin area a dose of 3,000 r and to the tonsillar area a dose of 2,000 to 3,000 r is recommended A half-value layer of 1.9 mm copper is used

If the tumor is in the posterior nasopharynx, it has been convenient and satisfactory to insert a radium applicator, in the form of a gold capsule with a 1-mm wall thickness, into the nasopharynx for a dose of 1,300 to 1,800 mg hours The cervical lymph nodes should be given all the radiation that normal tissues will tolerate



1



2

Figs 1 and 2 Case 1 Photographs of patient made on admission (1) and three months after treatment (2) Cervical node biopsy was reported lymphoepithelioma A dose of 9,500 r was applied to the left cervical nodes

Even though this is a radiosensitive tumor, one is not justified in using a small dose. One of our patients was given 7,800 r over the cervical nodes in a period of one year. The dose was administered in four series of treatments. In each case a half-value layer of 1.9 mm copper was used. We prefer relatively heavy filtration even though the tumor may be superficial.

As in all cases of malignant growth, we can only plead for more accuracy in diagnosis early in the disease. In our experience, distant metastases are not amenable to therapy and failure results. Relief of pain in our one case of bone metastases was far less striking than in similar metastases from carcinoma of the breast.

The patient whose primary tumor is in the tonsillar fossa, where it can be seen early, is fortunate. This, of course, is assuming that he appreciates the significance of the lesion sufficiently to seek aid early. The tumor in the eustachian canal or nasopharynx may never be found even

after distant metastases are present. If the symptoms outlined by New and others present themselves, the patient should be referred to a rhinologist for study. It is only through early diagnosis and rigorous therapy that any of these patients can be saved.

#### CASE HISTORIES

**CASE 1** (Figs 1 and 2) E. W., white male age 16, was first seen Jan. 4, 1935, complaining of a sore spot behind the angle of the jaw on the left. There had been slight swelling for one year, with recent rapid growth. Other symptoms were headaches, earache, and deafness of the left ear for about a year, and occasional vomiting episodes.

**Physical Examination** The left pupil was slightly irregular and the vision poor. There was a fixed mass about the size of a small lemon in the upper left cervical chain. On the right was a cervical node 1.0 cm in diameter, moderately tender. A posterior nasopharyngeal mass could be palpated.

**X-Ray Examination** On admission no lesion was demonstrable roentgenologically. Two years later there were evidences of lung metastases in the left base and suggestive erosion of the left greater wing of the sphenoid.

*Pathology* Biopsy of a left cervical node was reported "lymphoepithelioma"

*Treatment* From Jan 5, 1935, to April 9, 1937, a total dose of 9,500 r was given to the left cervical nodes. During the last year of life 2,000 r were given to the anterior and the same amount to the posterior left lung base, 2,000 r were applied to the left lateral skull. The enlarged node in the right cervical area receded promptly after 1,000 r.

The nasopharyngeal mass was treated with radium as follows. A 1-mm brass capsule was placed in the anterior nasopharynx for a dose of 120 mg hours, 300 mg hours was the dose used in the posterior left nasopharynx. The mass rapidly receded, so that breathing through this side became possible.

*Progress Notes* The patient returned on April 2, 1935, saying that he had felt well until ten days earlier, when his headache returned. His diplopia was gone. He had gained weight. No enlarged nodes were found.

In October 1935 there was again a complaint of diplopia, which had then been present for one month. A consultant reported paresis of the left sixth nerve. In May 1936, the patient was still working but was not free from headache. Lung metastases were diagnosed at this time. On March 7, 1937, physical examination showed a mass at the tip of the sternum that had been present for four months. The left pupil was dilated, both pupils were irregular and reaction to light was gone. The right eye showed slight light perception, acuity of the left eye was diminished. There was paresis of the third nerve on the left. Deafness was almost complete, bilaterally. No cervical mass could be found. Shortly before death, at home, the patient was reported to have passed blood in the urine. Death occurred on Aug 24, 1937. Duration of life from the onset of the first symptom was three and one-half years.

**CASE 2** L D S, white female, age 17, was seen Oct 13, 1937, with pain and swelling in the neck. She had noticed a small lump at the angle of the left mandible eleven months prior to admission. The lump has gradually increased in size until now it limited the movement of the mandible. The patient had been treated for sinusitis and tonsillitis.

*Physical Examination* There was a mass extending from the angle of the mandible to the clavicle, lobulated, and moderately tender. A tumor was found in the nasopharynx at the junction of the soft and hard palate. This extended downward to the level of the epiglottis, pushing the lateral pharyngeal wall to the mid-line and the uvula to the right. In the nasopharynx another tumor was found in the middle meatus on the left. It had the clinical appearance of a sarcoma.

*Pathology* Biopsy of the nasopharyngeal mass was reported "undifferentiated carcinoma which somewhat resembles a lymphoepithelioma."

*Treatment* X-ray therapy was given. During the two years that the patient was under observation

7,800 r were given to the left cervical mass and 2,800 r to the left antrum anteriorly, 1,050 mg hours of radium filtered with 1 mm of gold were given to the tumor in the nasopharynx.

*Progress Notes* On Aug 8, 1938, ten months after the original therapy, a node 1.5 cm in diameter was still present in the left cervical area. This was removed and was reported non-malignant. In October 1938, the patient complained of severe pain in the left side of the face, double vision, and inability to move her eyes. Antrotomy was done and tumor tissue was removed. It was reported as infected carcinoma, possibly lymphoepithelioma. Death occurred at home, Nov 23, 1939. Duration of life was three years from the first symptom.

**CASE 3** (Fig 3) C J, Negro female, age 17, was first seen in the outpatient dispensary in 1929, with enlarged cervical nodes. Nine years later she reported in the clinic with a wry neck. She was treated in various departments for wry neck, peritonsillar abscess, and arthritis. She was referred for x-ray therapy in April 1939, because of nodes in each cervical area. A tumor was suspected in the left tonsillar region, but the patient could not open her mouth sufficiently to permit a biopsy. Tonsils removed elsewhere in March 1939 did not show tumor growth.

*Treatment* A dose of 1,503 r to the left lateral pharynx and cervical area and 1,336 r to the posterior left cervical area was given. The torticollis disappeared and the patient became symptom-free. Treatment was given from April 25 to May 26, 1939.

*Progress Notes* The patient returned one year later with torticollis and pain, which were relieved by a similar series of treatments. On Feb 15, 1941, she entered the emergency room with a soft fluctuant mass in the posterior triangle of the left cervical area. A cystic mass was incised and a biopsy specimen was obtained from the margin.

*Pathology* The biopsy report was "lymphoepithelioma or transitional-cell carcinoma."

*Progress Notes* Further therapy consisted of 2,500 r to the lateral left cervical area and 2,500 r to the posterior cervical area on the left. X-ray examination revealed mediastinal metastases. A consultant in July 1941 thought there were brain metastases. Death occurred on Oct 22, 1941.

*Autopsy* There were metastatic deposits in the cervical, hilar, and mediastinal lymph nodes. The primary tumor was not found.

"Autopsy note: Death was probably due to the toxemia associated with an unusually rapidly growing malignant growth, apparently having its origin in the lymphadenoid tissues of the mouth and belonging to the so called lymphoepitheliomas. The biopsy specimen showed a much more characteristic and typical growth than the various recurrent nodules and metastases noted at autopsy."

The patient lived three and one-half years after her first symptom of torticollis.





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**Physical Examination** The left pupil was slightly irregular and the vision poor. There was a fixed mass about the size of a small lemon in the upper left cervical chain. On the right was a cervical node 1.0 cm in diameter, moderately tender. A posterior nasopharyngeal mass could be palpated.

**X-Ray Examination** On admission no lesion was demonstrable roentgenologically. Two years later there were evidences of lung metastases in the left base and suggestive erosion of the left greater wing of the sphenoid.

2,500 r, anterior left cervical nodes, 1,000 r, posterior left cervical nodes, 1,000 r

*Progress Notes* There was rapid regression of the mass of nodes. The patient returned on June 22, 1943, with many nodules beneath the skin of the scalp, arms, and abdomen. These varied from 0.5 to 2 cm in diameter. Death occurred on Aug. 3, 1943, at home. Duration of life was nine months from the first symptom. The primary tumor was never discovered.

**CASE 7** G. L., white male, age 60, was admitted Sept. 28, 1943, complaining of a lump in the neck.

*Progress Notes* This patient was last seen on Sept. 2, 1945, at which time no evidence of tumor was found. He had gained a little weight and was working at hard manual labor. Duration of life is two years and five months from the first symptom.

**CASE 8** (Figs. 4 and 5) N. W., white female, age 48, was admitted Oct. 11, 1943, complaining of pain in the back. Our first contact with this patient was when she was referred for cholecystography. It was noted that positioning her on the x-ray table caused a great deal of pain. A film of the dorsal spine showed 50 per cent compression of the 12th dorsal body.

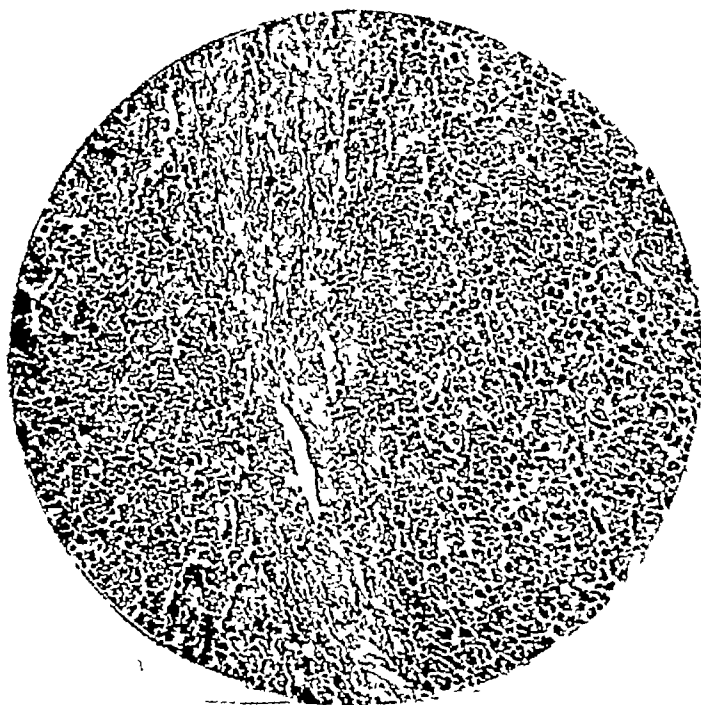


Fig. 4 Case 8 Biopsy specimen from nasopharyngeal tumor, reported lymphoepithelioma (Schmincke type)

Thus had started to develop in the right cervical area six months prior to admission.

*Physical Examination* There was a tender fixed mass in the right posterior auricular area and beneath the right ear. The right tonsil was large and ulcerated, measuring 2 cm in diameter. The cervical mass measured  $8 \times 2.5$  cm.

*Pathology* Biopsy of the cervical node was reported "lymphoepithelioma."

*Treatment* From Sept. 28 to Oct. 18, 1943, a dose of 2,847 r was given through a  $10 \times 10$  cm portal to the right cervical nodes, while 2,000 r were given intra-orally to the tonsil. In March 1944, since residual tumor was thought to be present in the nodes, they were given an additional 2,486 r.

The appearance was that of pathological compression. On questioning, the following history was obtained. In July a node the size of a walnut had been removed from the right axilla. It had been present for four months. The histologic diagnosis had been "malignant lymphoma." A node in the left axilla had been given x-ray therapy and had disappeared. The patient had been told by her family doctor that gallbladder disease was the cause of the back pain. Our initial assumption was metastasis to the vertebra from a malignant lymphoblastoma.

*Physical Examination* Small cervical nodes were present bilaterally. The blood count and blood chemistry were normal. X-ray showed metastases with compression of the 12th dorsal vertebra.

**CASE 4 E P**, white female, age 60, was admitted Sept. 20, 1940, with swelling about the left eye and nasal discharge. The drainage of the left nostril was blocked and there was loss of vision in the left eye. The first symptoms had appeared about three months prior to admission.

**Physical Examination** There was swelling of the left side of the face. A cellular tumor was found occluding the left nostril.

**X-Ray Examination** The left antrum was opaque, with destruction of the antral walls. The picture was that of a malignant tumor in the antrum.

**Pathology** Tissue removed from the nasopharynx was reported "lymphoepithelioma."

months' duration. He had first noticed a sore throat six months earlier but it had been more severe in the past two months.

**Physical Examination** There was an ulcerating, proliferating mass 3 cm in diameter in the left tonsil area. Cervical nodes, rather small and not fixed, were palpable.

**Pathology** "Lymphoepithelioma of the tonsil" (biopsy).

**Treatment** Radiation was directed intra-orally to the tonsil, 2,132 r. The cervical nodes were given 3,750 r.

**Progress Notes** The nodes and the primary lesion rapidly disappeared, and there had been no



Fig 3 Case 3 Biopsy specimen from cervical node, reported lymphoepithelioma

**Treatment** A dose of 2,000 r was applied to the lateral left orbit and antrum, 1,500 r to the anterior left antrum. The tumor rapidly regressed.

**Progress Notes** Four months later the patient was admitted with proptosis of the left eye and swelling of the left side of the face. Again 1,500 r were given to the anterior and also to the lateral left face. On final admission, March 1941, proptosis of the left eye was marked and brain metastases were suspected by consultants. Death occurred at home on June 2, 1941, one year after the first symptom.

**CASE 5 C M.**, white male, age 75, was admitted Nov 25, 1942, complaining of tonsillitis of two

recurrence up to Sept. 1, 1945, over three years since the first symptom.

**CASE 6 D E**, white male, aged 17, was admitted March 9, 1943, with a lump in the left side of the neck, present for four months. There were no symptoms referable to the nasopharynx.

**Physical Examination** There was a large mass of nodes in the left cervical and supraclavicular area. No lesion was demonstrable in the nasopharynx.

**Pathology** Biopsy of a cervical node was reported "lymphoepithelioma."

**Treatment** X-ray therapy to the nodes was administered as follows: left lateral cervical nodes,

condition. An indefinite small node about 1 cm in diameter was felt high in the cervical area on the left. The patient had no pain at that time and was gaining weight.

**CASE 10** J. L., white female, age 70, was admitted Aug. 18, 1944, with a sore throat (left side) of six weeks' duration.

*Physical Examination* There was an ulcerated, friable mass in the left tonsillar fossa, approximately 3 cm in diameter. No cervical nodes were felt.

*X-Ray Examination* No lung metastases were seen.

**CASE 11** L. F. S., white female, age 21, was admitted Oct. 16, 1944, complaining of sore, enlarged cervical nodes, left nasal obstruction and drainage, and left facial paralysis. The enlarged nodes were noticed a year earlier. Nasal obstruction became evident at about the same time. Facial paralysis had been present for three months.

*Physical Examination* There was horizontal nystagmus. The left pupil was dilated and showed a sluggish light reflex. The patient was unable to move the eye laterally, upward motion was poor, and she could not close the lid. There was lymphadenopathy in the cervical chain on each side and in

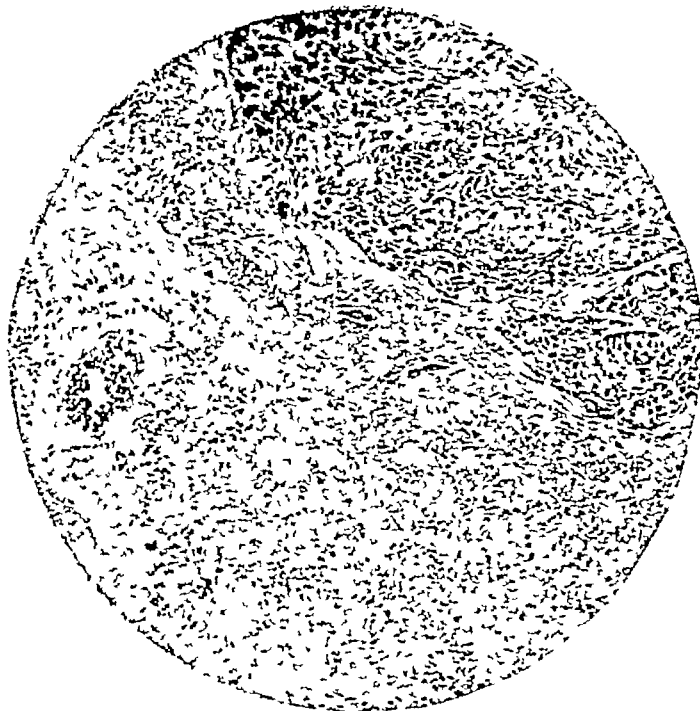


Fig. 6 Case 9. Biopsy specimen from tonsillar tumor, reported lymphoepithelioma.

*Pathology* Biopsy of the intra-oral mass was reported "lymphoepithelioma."

*Treatment* X-ray therapy was given to the intra-oral mass with a 3.5 cm cone, a dose of 1,548 r was directed to the primary tumor, 3,000 r were given to the left cervical area through a 10 × 10 cm portal.

*Progress Notes* The patient was last seen on Sept. 1, 1945. At that time there was no evidence of tumor. A point of interest is the fact that this woman was treated on the same service for a squamous cell carcinoma of the lip, Broders type II, four years earlier. This has shown no evidence of recurrence or metastasis.

This patient has gone a little over one year without evidence of recurrence of lymphoepithelioma.

the right and left occipital chain. A rather large mass was palpable in the posterior nasopharynx.

*Pathology* A large portion of the mass in the nasopharynx was removed. The pathological report was "lymphoepithelioma, Regaud type."

*Treatment* Treatment was given elsewhere.

**CASE 12** M. M., white female, age 81, was admitted Nov. 27, 1944, because of inability to breathe through the left nostril. She complained, also, of frequent nosebleeds. The naris had been occluded for about one year.

*Physical Examination* There was a pale, smooth mass occupying the left naris, exerting such a degree of pressure that the nose appeared swollen. Definite nodes were not palpated.



Fig 5 Case 8 Vertebral metastases from lympho-epithelioma of the nasopharynx

**Treatment** A dose of 1,700 r to the vertebra and 400 r to each cervical area was given. A brace was secured and the patient returned to her work as a teacher.

**Progress Notes** On Sept 19, 1944, the patient consulted a rhinologist because of a small growth in her nares that was causing a little obstruction. She had been conscious of it for four months but since it had not caused any discomfort she had ignored it. Examination revealed a tumor 1 cm in diameter in the posterior left nasopharynx. It was soft in consistency and not vascular. It was partly removed with an adenotome. Radium in a capsule 1.5 cm long, filtered with 1 cm of gold, was applied for a total dose of 1,200 mg hours.

The next admission was on Dec 26, 1944, because of a recurrence of pain in the back, referred to the left side. This was severe in the left upper quadrant. Muscle spasm was so pronounced that adequate examination could not be done. The impression was gained that the spleen was about twice as large as normal. The patient refused to stay in the hospital for an adequate amount of therapy to the spine. On Feb 22, 1945, she returned with fluid in the left pleural cavity, and 1,110 cc of blood-tinged fluid

was removed. Fluid was removed on several occasions during the next two months. The last admission was from March 16 to April 10, 1945. Blood chemistry was normal, the white cell count was 5,300 and hemoglobin 68 per cent. Fluid was again removed from the pleural cavity and transfusions were given. The patient realized her condition and asked to be released to return to her home.

**Pathology** The biopsy report on the nasopharyngeal mass was as follows: "The section shows a number of irregular masses of tissue, some of which are covered on the surface in part by a layer of squamous epithelium, beneath which are extensive areas of lymphoid tissue. There are innumerable pleomorphic cells with a moderate amount of cytoplasm and relatively large pale staining nuclei, often showing considerable irregular lobulation and commonly containing a prominent eosinophilic nucleolus. The malignant cells commonly exhibit mitotic figures, sometimes quite bizarre in form, and the cells show a diffusely infiltrative type of growth extending irregularly throughout the lymphoid tissue but showing here and there a tendency to form poorly defined clumps and masses, suggesting epithelial origin. They are in some areas, however, intimately intermingled with lymphoid and hyaline collagen bundles. Diagnosis: Lymphoepithelioma (Schmincke type)."

The patient died on May 20, 1945. Duration of life was three years from the first symptom.

**CASE 9 (Fig 6)** E. O., white male, age 61, was admitted Aug 16, 1944, complaining of a sore tonsil. Sore throat and a mass of nodes in the left cervical region had appeared simultaneously about two months prior to admission.

**Physical Examination** There was a large ulcerated left tonsil, forming a mass approximately 3 cm in diameter. The mass of nodes in the left cervical region measured 5 x 8 cm and was fixed. Small supraclavicular nodes were also present on the left.

**Pathology** Biopsy of the primary lesion in the tonsil was reported "lymphoepithelioma, Regaud type."

**Treatment** Four series of treatments were given in a period of one year. During the first month of treatment a dose of 1,548 r was applied intra-orally to the left tonsil. From Aug 16, 1944, until Aug 20, 1945, the total dose was as follows:

Intra-oral to left tonsil	1,548 r
Left lateral cervical area	9,150 r
Left supraclavicular nodes—	3,315 r
Submental nodes	3,315 r

The intra-oral portal was 3.5 cm in diameter and the external areas were treated through a portal 10 x 10 cm. A half-value layer of 1.9 mm copper was secured with a Thoreaus filter.

The primary tumor promptly disappeared, but the nodes were much more resistant. On examination, on Sept 1, 1945, the skin was found to be in good

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## CASE SUMMARY

Case Number	Age	Sex	Duration from First Symptom	First Symptom	Other Symptoms	Living or Dead
1	16	M	3 1/2 years	Cervical lymph node enlargement	Headache, earache, deafness, diplopia, irregular pupil, metastases to sternum	Dead
2	17	F	3 years	Cervical lymph node enlargement	Double vision, pain in neck, obstruction of nares, mass in nasopharynx	Dead
3	17	F	3 1/2 years	Torticollis	Cervical mass, general metastases	Dead
4	60	F	1 year	Swelling of soft tissue about eye	Occlusion of antrum, proptosis left eye	Dead
5	75	M	3 years	Enlarged tonsil and cervical nodes	None	Living
6	17	M	2 1/4 years	Cervical nodes	Skin metastases	Dead
7	60	M	2 1/2 years	Enlarged tonsil and cervical nodes	None	Living
8	48	F	3 years	Node in axilla	Metastases to vertebrae, lung, and spleen	Dead
9	61	M	1 year	Sore throat	Ulcerated tonsil, large cervical nodes	Living
10	70	F	1 year	Sore throat	Ulcerated tonsil, enlarged cervical nodes	Living
11	21	F	2 years	Cervical nodes, mass in nares	Nystagmus, third nerve paralysis left pupil dilated	Living
12	81	F	1 1/4 years	Occluded naris	Nosebleeds	Living

*Pathology* "Lymphoepithelioma or transitional-cell carcinoma"

*Treatment* Following removal of a portion of the mass, a capsule of radium containing 50 mg and having a length of 1.5 cm was inserted adjacent to the tumor. Filtration was 1 mm of gold. A total dose of 1,550 mg hours was applied, roentgen radiation (1,500 r) was delivered to the left face and cervical area.

*Progress Note* The patient's condition on Sept 1, 1945, was good. She had then been living one and three fourths years without recurrence since the original evidence of tumor.

## SUMMARY AND COMMENT

1 Primary malignant neoplasms of the nasopharynx are being recognized more frequently.

2 Lymphoepithelioma is an uncommon tumor arising in this location. It is characterized by a cell type that usually but not always differentiates it from transitional-cell carcinoma. Clinically the site of the primary lesion, the mode of metastasis, and response to irradiation are the same for the two tumors.

3 In our series of 12 cases the average duration of life was two and one-half years for those who are dead. Six of the series are living, their average duration of life being two years. Of the 6 living patients, 5 had a primary tonsillar tumor and one

a primary nasopharyngeal tumor. Five of the series were between the ages of 16 and 21, the other 7 were between 48 and 81. 8 were females and 4 males.

4 Therapy should be started as soon as diagnosis is made and should be intensive. Radium and x-ray therapy deserve equal consideration. The type of radiation used will depend on the facilities available and accessibility of the tumor.

5 Evidence seems to the author to favor a specific tumor called lymphoepithelioma. Whether transitional-cell carcinoma, undifferentiated-cell carcinoma, and lymphoepithelioma are essentially the same has not yet been definitely settled by the pathologist. For therapeutic purposes, the matter is of academic interest. In either case the problem is referred to the radiologist. His success will depend largely upon the stage of the disease and the heroism with which he attacks the problem.

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Fig 1 Osteosclerosis along the sacroiliac joints, characteristic of the earlier stages of Marie-Strümpell's spondylitis

Fig 2 Osteosclerosis of the ilium at some distance from the sacroiliac joint

Fig 3 Same case as Fig 2, four years later The pattern (size and shape) of the osteosclerosis has changed considerably



# Significance of the Sacroiliac Findings in Marie-Strumpell's Spondylitis<sup>1</sup>

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THE CONDITION called Marie-Strumpell's spondylitis in America was first described by Strumpell in 1884. From a study of the clinical symptoms, he concluded that the disease might result from a chronic inflammation of the intervertebral joints. As to the question in which part of the spine the disease begins, he expressed no opinion. Marie, in 1898, was the first to answer that question. Since patients usually gave the lower back as the site of the first symptoms, and since the lumbar spine was often found to be ankylosed while the cervical spine was less affected, Marie concluded that the disease "marches progressively in the ascending direction, from the sacrum to the neck."

X-ray studies have added weight to the theory of Marie. In 1934, the British radiologist Scott expressed the opinion that "changes in the sacroiliac joints always precede the onset of spondylitis." Forestier (France) corroborated the findings of Scott in 1939, and Hare in America joined them in their opinion in 1940. At present the theory that "in spondylitis adolescens the sacroiliac joints are first to be attacked by the fixation process" (Blair) appears to be generally accepted. My studies, however, of over 200 cases in the last two decades<sup>2</sup> have given me an opportunity to make some observations which, if corroborated by others, would seem to lead to a conclusion at some variance with the prevailing opinion.

Let us start with an analysis of the sacroiliac findings in patients with Marie-Strumpell's disease, since such observations form the basis of all discussions on this subject. The most important thing

to be said of these findings is that they are a manifestation of a process of continuous transformation of the bone structure. They are not uniform, therefore, but vary considerably in the course of the disease. This may account for differences in the studies published on the subject. Two main stages may be distinguished, differing from each other in so many respects that they should be discussed separately.

## STAGE OF PARASACROILIAC OSTEOSCLEROSIS

The earlier stage is characterized roentgenologically by an increased density of the sacroiliac region (Fig 1). In the beginning, a trabecular arrangement is discernible within the condensed area, later there is a total loss of structural details. The area of condensation is sharply but irregularly delineated. Its size and shape vary to a certain extent in the course of the disease (Figs 2 and 3). From the very beginning the process of condensation is in the great majority of the cases symmetrical, so that one side looks like a mirror-image of the other.

As to the localization of the process, the condensation extends along the sacroiliac joints. Two points need to be stressed. First, the osteosclerotic area is limited to the iliac bones. The impression that the sacrum is affected as well is due to the fact that "the articular portion of the ilium extends behind the anterior edge of the sacroiliac joint, so that the portion of the ilium which lies behind the sacrum may give the appearance of disease of the sacrum" (Hare and Haggart). Actually, the sacrum is involved only in the later stages of the disease, and even then only infrequently.

<sup>1</sup> Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov 9-10, 1945.

<sup>2</sup> The cases were seen in the following institutions: General Hospital, Vienna; Rothschild Hospital, Vienna; Clinic of N Y University; Hospital for Ruptured and Crippled, New York; Welfare Hospital, N Y.

present in my cases of Marie-Strumpell's spondylitis. Other tests used in examinations of the sacroiliac joints, such as the signs of Lasègue, Gaenslein, and Smith-Petersen, were also found to be negative in 42 of my cases with parasacroiliac osteosclerosis. On the other hand, the symptoms of which the patients with parasacroiliac osteosclerosis usually complain are "pains, stiffness in the spine, with muscular contracture, and impairment of the chest expansion" (Forestier). Obviously, none of these can be referred to the findings in the sacroiliac region but point to a lesion of the spinal column at a higher level.

I have not found in the literature any report indicating the presence of pathological findings characteristic of Marie-Strumpell's disease in this early stage. No inflammatory process, no proliferation of the synovial membrane, no pannus destroying the cartilages has been described in the sacroiliac joints, to my knowledge. Scott explored the affected bone from the bacteriological point of view and found it sterile. In a case of "ilutis condensans," which radiologically is closely related to the parasacroiliac osteosclerosis in Marie-Strumpell cases, the affected bone was found on the microscopic examination to be "independent of any inflammatory or other etiology," according to Rendich and Shapiro. Thus the interpretation of the radiological findings in the sacroiliac joints as a manifestation of Marie-Strumpell's spondylitis is not based on pathological studies.

If we compare the early sacroiliac findings with those in the intervertebral joints, we find in the latter, radiologically, "stippled or diffuse rarefaction of articular processes, ranging from slight loss of the density to almost complete dissolution of the bone. The facets of the involved articular processes have indistinct outlines. The intervening joint space is slightly narrowed and sometimes clouded" (Oppenheimer). Clinically, there is pain on motion and on pressure to these joints, with spasm and stiffness. Pathologically,

an inflammatory edema, proliferation of the synovia, and destruction of the cartilage have been definitely established (Fraenkel, Sivéén, Junghanns, and others).

In every respect, therefore, there is a contrast between the findings in the sacroiliac joints and in the intervertebral joints in the early stage of the disease. In the end we arrive at the somewhat strange conclusion that, according to the prevailing theory, Marie-Strumpell's spondylitis, known to be a radiologically and pathologically well defined, clinically painful disease of the joints, should start with a pathologically obscure, clinically silent affection of the bone.

On the other hand, there is a strong argument in favor of the identity of the pathological process in the sacroiliac joints and in the other joints affected by the disease, in the fact that the stage of parasacroiliac osteosclerosis is followed by an ankylosis of the sacroiliac joints.

#### STAGE OF ANKYLOSIS OF THE SACROILIAC JOINTS

Serial roentgen examinations extended over many years demonstrate that, as Marie-Strumpell's spondylitis advances, a process of decalcification sets in, in the spine as well as in the pelvis, and progresses continuously. While the decalcification goes on, the sclerosis of the bones around the sacroiliac joints gradually diminishes. Since the condensed area contains more calcium than the normal bone, the decalcification is first seen, and for a long period of time is more pronounced, in the bones of the spine and pelvis than in the sclerotic areas. Eventually, however, there is a uniform demineralization around the sacroiliac joints, with a complete loss of structural details. Coincidentally, the joint space displays irregularities of outline and alterations of width. A process of obliteration sets in, which steadily progresses until a complete osseous ankylosis results. The sacrum and ilium form then a single bone with a greatly diminished calcium content (Fig 5). This can be demonstrated also in oblique views (Fig 6).



Fig 4 Oblique view of a sacroiliac joint showing that in the stage of osteosclerosis the contours and width of the joint space are normal

Secondly, the sacroiliac joints are not affected. The impression that the joint is involved is created by the fact that "the sacroiliac joint is oblique, the large auricular surface of the sacrum, facing outwards and backwards, opposes to a similar surface in the ilium, which faces forwards and inwards. Therefore, in the anteroposterior radiograph the lateral borders of the sacrum overlap and the medial borders of the ilia and the joint space cannot be seen" (Brailsford)

The presence of a sclerotic area seemingly surrounding the joint tends to increase the difficulty in evaluating the condition of the sacroiliac joints. Depending on the distribution of the sclerotic area, the joints may appear blurred and narrowed or, in other cases, scalloped and widened on the routine anteroposterior roentgenogram. Anteroposterior films taken from a 45-degree angle, however, or oblique views demonstrate that in the stage of para-

articular osteosclerosis the sacroiliac joints are normal as to their contours and width (Fig 4)

Thus we see that in this stage of the disease the radiological findings in the sacroiliac region do not indicate the presence of a "sacroilitis" but merely of an "ilitis." In fact, the radiologic findings are similar to those in "osteitis condensans ilii," as recently stressed by Hare and Haggart. It is only in order to describe the portion of the ilium in which the changes are found that we speak of "sacroiliac" findings and not merely of iliac findings in Marie-Strümpell's spondylitis.

As to the clinical symptoms in this stage of the disease, it is significant that, though many patients complain of pain in the buttocks, in the neighborhood of the sacroiliac joints, pain is not localized in the joints themselves. "It is difficult," wrote Scott, "to explain why pain should be absent from the sacroiliac joint during the most active stage of the infectious process," but "for some unexplained reason pain is not localized in the sacroiliac joints." Similarly there is absence of pain on pressure to the sacroiliac joints. According to Forestier, "it is remarkable that, as a rule, no pain was elicited by pressure at the site of the sacroiliac joints." Both these phenomena, however, are understandable in the light of the fact mentioned above, namely, that we are dealing here not with a process in the sacroiliac joints but in the iliac bones. In "osteitis condensans ilii" there is likewise no pain in the area of condensation, either spontaneously or on pressure.

Since pain is the cause of all the other symptoms in sacroiliac conditions, its absence explains the absence of any other clinical findings referable to sclerosis in the sacroiliac region. A patient suffering from a sacroiliac sprain or sacroiliac tuberculosis, does not sit on the buttock of the affected side because he seeks to avoid the transmission of weight through the joint. When he stands or walks, he is likely to press his hand over the joint to lend it better support (Lewin). None of these signs was

present in my cases of Marie-Strumpell's spondylitis. Other tests used in examinations of the sacroiliac joints, such as the signs of Lasègue, Gaenslein, and Smith-Petersen, were also found to be negative in 42 of my cases with parasacroiliac osteosclerosis. On the other hand, the symptoms of which the patients with parasacroiliac osteosclerosis usually complain are "pains, stiffness in the spine, with muscular contracture, and impairment of the chest expansion" (Forestier). Obviously, none of these can be referred to the findings in the sacroiliac region but point to a lesion of the spinal column at a higher level.

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Fig 5 Same case as Fig 1, six years later The sacroiliac joints are now fused, the pelvic bones are decalcified, the spinal ligaments are ossified

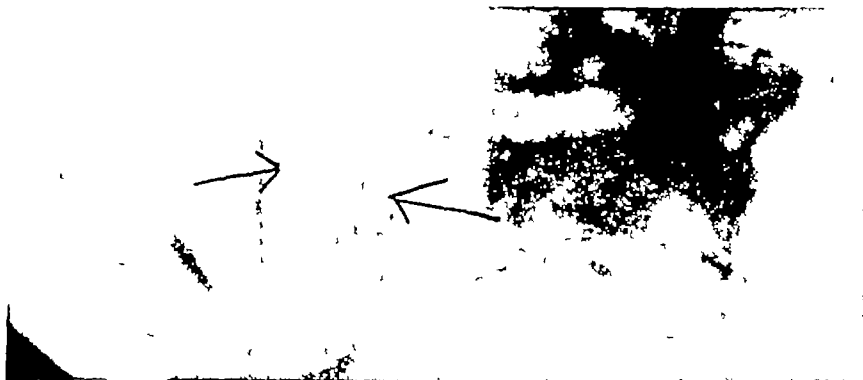


Fig 6 Same case as Fig 5 The sacroiliac joint is shown to be fused also in the oblique view in contrast to Fig 4

The osseous ankylosis of a joint is definitely an arthritic process, indicating loss of the articular cartilages and their replacement by a newly formed osseous tissue. The radiological findings adequately picture the pathological state of

the joints. This has its parallel in the final stage of Marie-Strumpell's disease in other joints, as well as in rheumatoid arthritis. There is, however, one fact to be taken into consideration before conclusions are drawn from this parallelism,

namely, that an ankylosis occurs in the sacroiliac joints spontaneously in the course of the aging process. This is in line with the anatomy and physiology peculiar to the sacroiliac joints and foreign to any other joint. Up to about the thirtieth year of life the sacroiliac joint is structurally, as well as functionally, a true diarthrodial joint, lined with a synovial membrane and forming a joint space permitting some motion. This is followed by a stage in which the synovial membrane be-

comes atrophic, the cartilage begins to degenerate, and the joint space is gradually obliterated so that a synchondrosis results, permitting practically no motion. Finally, in old age, when a senile osteoporosis sets in, the cartilages show a tendency to fuse into synostosis (Fig 7). This tendency of the sacroiliac joints to be gradually transformed from a diarthrosis through a synchondrosis into a synostosis was first established by Barkow, in 1841, and subsequently corroborated by Brooke and Léri. In America, Sashin (1930) and Willis (1933) have published important contributions on the subject, essentially confirming the previous reports. Sashin stated that, "since the entire weight of the body is transmitted through the sacroiliac

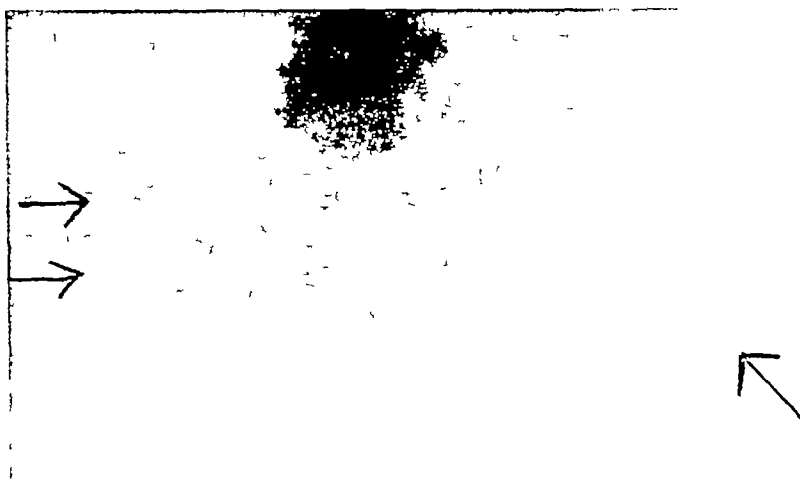


Fig 7 Senile osteoporosis with fusion of the sacroiliac joints

joints to the lower limbs as a result of this constant pounding or pressure effect upon the articular surfaces, early degenerative and osteoarthritic changes set in which eventually lead to bone ankylosis." Willis arrived at a similar conclusion. "The sacroiliacs were ankylosed by bone productive changes more frequently than any other joints. They were often completely fixed when the other parts of the same skeleton showed little if any similar change."

It appears that while an osseous ankylosis in any other joint affected by Marie-Strumpell's disease can be regarded as evidence of a destruction of the articular cartilages by an inflammatory process, this cannot be taken for granted in the sacroiliac joints. Here the fusion may be the result of the ordinary degeneration spontaneously occurring in these joints. There are a few things to suggest that, in fact, the ankylosis in the late stages of Marie-Strumpell's spondylitis may have something to do with the ankylosis observed in the course of the aging process. There is first the fact that no pannus destroying cartilages has been thus far reported in the sacroiliac joints. This may be due to the fact that the synovial membrane of

these joints has a tendency to atrophy and thus is unable to produce the granulomatous tissue (pannus) characteristic of Marie-Strumpell's spondylitis and rheumatoid arthritis, respectively. The fact also is remarkable that, as stressed by both Sashin and Willis, the process of degeneration and fusion of the sacroiliac joints is more frequent, sets in earlier, and progresses more rapidly in males than in females. These findings are of particular

of these joints, namely, that of the synovial membrane to atrophy, that of the articular cartilages to degenerate, and that of the neighboring bones to fuse, are intensified in the presence of Marie-Strumpell's disease. The disease would seem to intensify the efficacy of the factors responsible for the ankylosis of the sacroiliac joints in the course of the aging process and thereby to accelerate the establishment of that condition.



Fig 8 Lateral view of a sacroiliac joint showing osteosclerosis of both the ilium and sacrum

interest in view of the fact that Marie-Strumpell's disease occurs predominantly in young males. Finally and most important the ankylosis of the sacroiliac joints in Marie-Strumpell's spondylitis is associated with a decalcification of the bones just as their ankylosis in old age is associated with senile osteoporosis.

In conclusion, we see that the ankylosis of the sacroiliac joints in the course of Marie-Strumpell's spondylitis is not necessarily the result of the pathological process peculiar to that disease but rather of the physio-anatomical processes peculiar to the sacroiliac joints. The idea suggests itself that the tendencies characteristic

If we now compare the two main stages in the development of the sacroiliac findings in Marie-Strumpell's disease, we see that a process primarily localized in the bone is succeeded by a process in the adjacent joints. Despite their morphologically different appearances, the para-articular osteosclerosis and the osseous ankylosis have two features in common, first their symmetry and secondly the increased content of calcium. Lime salts are deposited in excessive amounts symmetrically, first in the bones near the sacroiliac joints and then, when the bones become decalcified, in the intra-articular spaces of those joints. The two processes seem to be merely two

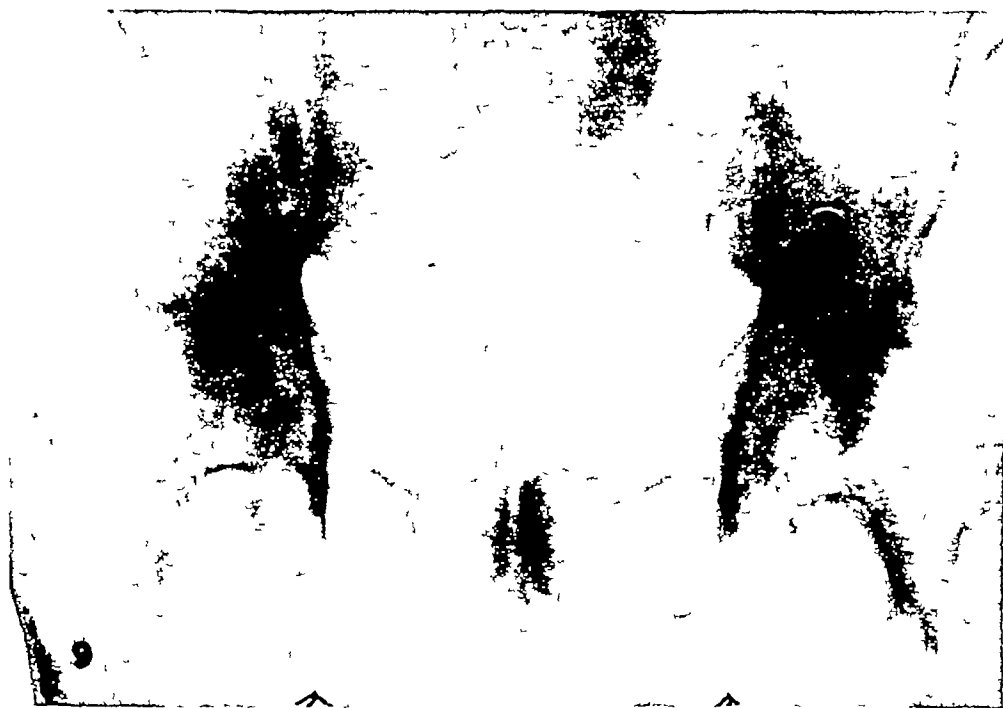


Fig 9 Advanced case of Marie-Strümpell's spondylitis showing fusion of the sacroiliac joints and osteosclerosis around the sacrolumbar junction



Fig 10 Same case as Fig 9, two years later. There is, in addition to the previous findings, a proliferation of the periosteum of the tuberosities of the ischium



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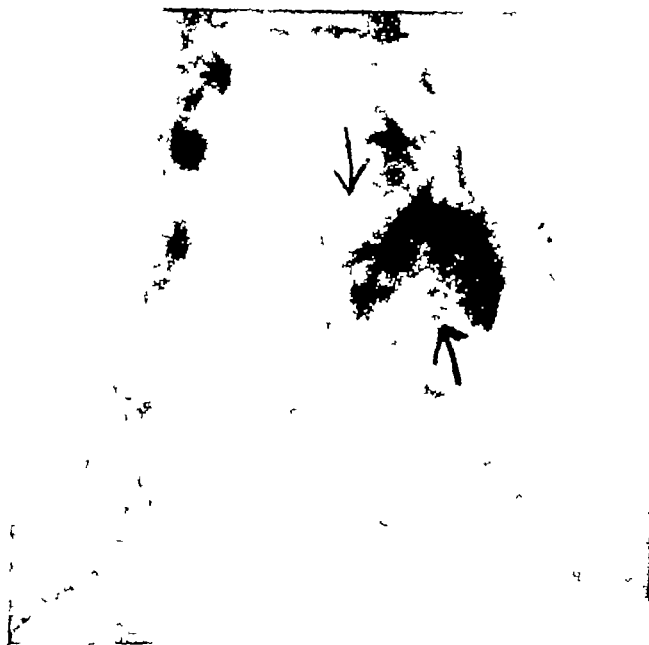


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Fig 12 Narrowing of an intervertebral joint with periarthral sclerosis in an early case of Marie-Strumpell's spondylitis

terior, lateral, and oblique views, to serve as a standard in the study of pathological cases

In 32 early cases of Marie-Strumpell's spondylitis in which routine anteroposterior views showed a para-articular osteosclerosis in the sacroiliac region, the lumbar spine was examined in the oblique view also. All, without a single exception, showed definite pathological changes of the intervertebral joints, such as blurring of the contours, narrowing of the joint space, condensation or decalcification of the facets (Fig 12). These findings have been thoroughly described by Oppenheimer in his important contribution on the subject. Surprisingly enough, the first definite signs of the disease are very frequently found in the upper lumbar spine and lower dorsal spine, between D11 and L2 (Fig 13), much farther from the sacroiliac region than they are commonly expected. This, too, may be a factor explaining why the changes often are overlooked.

Forty-one late cases, showing an ankylosis of the sacroiliac joints, revealed the presence of advanced changes in the spinal column, such as ankylosis of the intervertebral joints, extensive calcification of the spinal ligaments, and definite osteoporosis of the vertebrae and pelvis.

Thus we found that, whenever the sacroiliac region was involved, the lumbar spine was affected as well. This has a counterpart in the observation of Oppenheimer that in a number of cases "the sacroiliac joints were normal both on clinical and

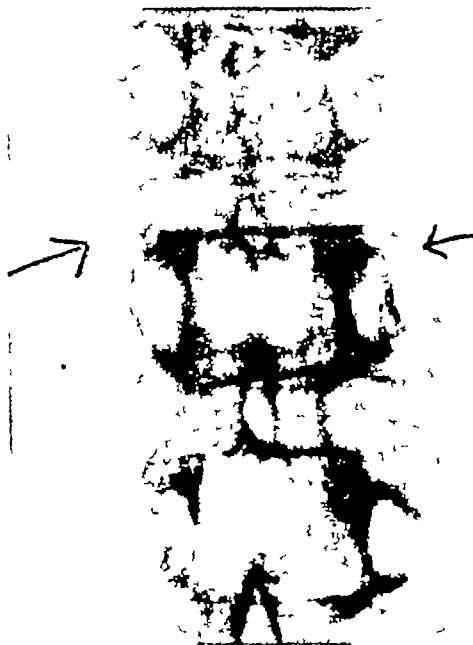


Fig 13 Calcification of parts of the spinal ligaments between D11 and D12. The corresponding intervertebral joints are ankylosed.

roentgenological examination, in these cases the apophyseal joint lesion was confined to the thoracic or cervical vertebrae." In other words, in the absence of changes in the lumbar spine, changes in the sacroiliac region also are absent. On the other hand, we found in our series no instance of pathological findings in the lumbar spine without changes in the sacroiliac region, although in some cases the latter were so slight that they escaped many observers. The absence of cases with negative sacroiliac findings in the presence of changes in the lumbar spine in our series is perhaps due to the fact that the initial symptoms of Marie-Strumpell's spondylitis are so vague and insidious that many patients do not see a physician in the early stage of the disease. In some of our cases the disease was not suspected by the physician who first saw the patient and roentgenograms of the spine were not taken. In other cases the lumbar and dorsal spine showed roentgen changes characteristic of beginning Marie-Strumpell's spondylitis but the sacroiliac region was not examined because no symptoms referable to that area were present. Scott, however, despite his

different ways of bringing about the same effect, namely, an increase of the calcium content of the pelvic bones supporting the spine

#### PELVIC CHANGES OUTSIDE THE SACROILIAC REGION

It has been mentioned that what we see in the sacroiliac region of Marie-Strümpell's spondylitis is a continuous transformation of the bone structure. The process is first limited to the iliac bones. But it does not stop there. As the condi-

tical distribution and an increased calcium content

#### RELATIONSHIP BETWEEN THE SACROILIAC FINDINGS AND THE LUMBAR SPINE

The theory that Marie-Strümpell's spondylitis begins in the sacroiliac joints and then progresses toward the lumbar spine is based on routine examinations of the spinal column in the anteroposterior and lateral views. Progress, however, has been made in the radiological examination of the spine since it has been studied also in the



Fig. 11 Case of Marie-Strümpell's spondylitis of twenty years' duration. In addition to the fusion of the sacroiliac joints, there was an osteosclerosis of the bones forming the symphysis pubis

tion advances, some cases show osteosclerotic areas in the sacrum as well (Fig. 8). There is sometimes, also, a condensation of the bones around the sacrolumbar junction (Fig. 9). Later, a new area of osteosclerosis may develop in the region of the symphysis (Fig. 11). Finally, the periosteum of the tuberosities of the ischium, sometimes also that of the ilium, starts to proliferate and, as a result, bony spicules are formed, radiating into the adjacent soft tissues, producing a sunray appearance (Figs. 9 and 10).

The pelvic changes show the same two features which were found to characterize the sacroiliac lesions, namely, a symmet-

oblique direction. Oblique views give us a clear insight into the intervertebral joints, the primary site of Marie-Strümpell's spondylitis. Because of the smallness of the intervertebral joints, alterations are not so conspicuous as in the large sacroiliac joints, and therefore are readily overlooked. Once we are familiar with the normal appearance of the intervertebral joints, however, the diagnostic evaluation of pathological alterations occurring in these joints does not offer more difficulties than, for example, in the phalangeal joints.

In 10 healthy subjects, twenty to thirty-five years of age, films of the lumbar and sacral region were studied in anteropos-

theory that the disease starts in the sacroiliac joints, I began to irradiate that region

If the ineffectiveness of the x-ray treatment of the sacroiliac joints escaped Scott, this is to be attributed to his so-called "wide-field" technic. With this method, treatments are given from a long distance so that the entire trunk is exposed to the rays. Consequently, both the sacroiliac joints and the spine are irradiated, so that the ineffectiveness of the irradiation of the sacroiliac region is not apparent.

Forestier used radioactive injections intramuscularly or intravenously, so that here, too, the entire body was exposed to the action of the rays, and the ineffectiveness of the treatment of the sacroiliac joints again escaped attention.

Hare directed the rays "to the entire spine, the sacroiliac joints, and the paravertebral and gluteal muscles." He used 6 portals, on 6 successive days. Under these circumstances he had no chance to ascertain whether the favorable result of the therapy was due to the treatment of the sacroiliac joints or the other areas.

The ineffectiveness of irradiation of the sacroiliac joints for pain localized in their neighborhood becomes, however, unequivocal if we treat one region at a time and the next region only when the result of the previous treatment is ascertained. Applying the same dose to all regions treated, we find that irradiation of the sacroiliac joints is never successful. By contrast, the pain localized in their neighborhood subsides if the lumbar spine is irradiated. This suggests that the pain around the sacroiliac joints does not originate in the joints but is merely referred from the lumbar region.

The ineffectiveness of irradiation of the sacroiliac joints manifests itself in still another way. If the sacroiliac joints are in the stage of para-articular osteosclerosis and are irradiated directly, the development of an ankylosis of these joints cannot be prevented. If, however, in this stage x-rays are directed not to the sacroiliac joints but to the lumbar spine, and if these treatments are successful in decreasing



Fig 15 Same case as Fig 14, two years later. The osteosclerosis is now bilateral.

pain and increasing motility, ankylosis of the sacroiliac joint fails to develop. This impressive course of events suggests that the development of the sacroiliac findings is not invariable but is controlled by influences originating in the lumbar spine. The practical conclusion following from these observations is that, in treating Marie-Strumpell's spondylitis with x-rays, irradiation to the sacroiliac joints should be omitted. It is a waste of time and expenditure, it may discourage the patients and the attending physicians from the further use of x-ray therapy, in females it is harmful to the ovaries, without any compensating benefit.

#### SUMMARY AND CONCLUSIONS

1 The osteosclerosis in the sacroiliac region seen in the early stages of Marie-Strumpell's spondylitis is confined to the iliac bones, leaving the sacroiliac joints free. The findings demonstrate a pathological process of the bone but not a disease of the joint.

2 The ankylosis of the sacroiliac joints seen in the late stages of Marie-Strumpell's spondylitis has not been proved to result from a destruction of the cartilages by a pannus, as is the case in other joints affected by the disease. On the other

assertion that the "changes in the sacroiliac region always precede the onset of spondylitis," admitted that "a small percentage of cases showed no sacroilitis on the first examination but some time later" Scott worked in a hospital specializing in the treatment of rheumatic diseases, in which x-ray films of the sacroiliac region were routinely taken in all younger persons complaining of backache. Early cases with negative findings in the sacroiliac region could be detected under these circumstances. Such cases are, necessarily, as

#### THE SACROILIAC FINDINGS AND X-RAY THERAPY

The effectiveness of x-ray therapy in Marie-Strumpell's spondylitis, especially in the pre-ankylositic stages, becomes more and more common knowledge (Scott, Hare, Oppenheimer, Smyth, Freyberg, and Lampe, Baker, Rees and Murphy, and others). Treatment of "ankylosing spondylarthritis" with x-ray is mentioned by Professor G. Holzknacht of Vienna in his book "Dosage Tables for X-Ray Therapy," 1922.<sup>3</sup> Being for many years in



Fig 14 Unilateral osteosclerosis of the ilium in a case of Marie Strumpell's spondylitis

rare as those showing the initial stages of any other chronic condition.

It is less unusual to see cases in which, in the presence of well defined findings in the lumbar spine, only one sacroiliac joint is affected on the first examination (Fig 14). Later in the course of the disease the other sacroiliac becomes affected as well (Fig 15). Here it is evident that the changes in the lumbar spine preceded at least those in one of the sacroiliac joints. Such cases are suggestive of the presumable development of the sacroiliac findings in relationship to those in the lumbar spine at the very onset of the disease.

charge of x-ray therapy in Holzknacht's clinic, I had the opportunity of treating cases of Marie-Strumpell's spondylitis as early as twenty years ago. At that time the diagnosis was considered certain only when the spine showed marked ossification of the ligaments. Usually, therefore, only advanced cases were treated. Nevertheless, the pain-alleviating effect was impressive and highly appreciated by both patients and attending physicians. This changed, however, when, following the

<sup>3</sup> An English translation of these tables is included by I. Seth Hirsch in his book "Principles and Practice of Roentgen Therapy" (1925).

presence of an inflammatory process in the body, while the increased calcium content in the sacroiliac region indicates the presence of an immobilizing process in the neighborhood of the joints. The increased sedimentation rate can be likened to the increased temperature, the sacroiliac reaction to the "*defense musculaire*" in appendicitis. Though not a mirror, as an indicator of certain pathological processes in the lumbar spine, the sacroiliac reaction is a very important aid in the diagnosis of Marie-Strümpell's spondylitis. The diagnosis, however, can be regarded as definitely established only when, in addition to the sacroiliac findings, pathological changes are also demonstrated in the intervertebral joints, the primary site of the disease.

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hand, it has its analogy in a process peculiar to the sacroiliac joints leading to their ankylosis in the course of the aging process

3 The sacroiliac findings do not give rise either to pain or any other clinical symptoms. The symptoms encountered in patients with sacroiliac findings point to the lumbar spine as the site of origin.

4 X-ray therapy given to the sacroiliac region is ineffective. It does not alleviate any symptoms nor does it prevent ankylosis. By contrast, the symptoms around the sacroiliac joints subside and ankylosis is prevented when the lumbar spine is irradiated.

In view of these facts, the following conclusions may be tentatively drawn.

The inflammatory process taking place in the spinal joints affected by Marie-Strumpell's spondylitis causes pain, spasm, and stiffness. A chronically progressive restriction of mobility results. Such a restriction of the mobility of one part of a body naturally has some adverse effects on the parts with which it is anatomically connected. In the case of the lumbar spine, the longer it is immobilized, the more it becomes functionally integrated into the pelvis. As a result, a bigger block of bones is formed, requiring a stronger support. This induces a chain of physiological reactions tending to restore the weight-bearing capacity of the sacroiliac junctions, which are severely taxed by the disorder. As the final result of these processes, larger amounts of calcium are deposited in the regions affected, so that the increased stress resting on these pillars is counterbalanced. The symmetry of the sacroiliac findings seen in the great majority of cases, even in the earliest stages, points in that direction. The os ilii, being the largest pelvic bone, is first involved and contributes to this end more than the others. The calcium is first deposited along the joints in the direction of "the lines of force," a well known method of adaptation of the bone to an increased stress (Skinner). Later, a uniformly dense sclerosis results. Presumably, when the condensation of the

iliac bones proves insufficient to increase the weight-bearing capacity of the pelvis, there is sometimes also a condensation of parts of the sacrum and of the bones around the lumbosacral junction. Later, a new area of condensation develops in the region of the symphysis as symmetrical as in the sacroiliac region.

When in the course of the disease, due to the progressing immobilization, a decalcification of the bones sets in, new bone is formed outside the normal skeleton. The osseous ankylosis of the sacroiliac joints illustrates this way of satisfying the demands for a better support. The bone is formed and deposited in the articular spaces of the sacroiliac joints, as is the case in the ankylosis of these joints occurring in the course of senile osteoporosis. Another instance is the proliferation of the periosteum of the tuberosities of the ischium, giving rise to the formation of bony spicules radiating into the soft tissues.

The assumed type of relationship between the sacroiliac and lumbar findings may account for the fact that, while in cases with sacroiliac findings pathological changes invariably were present, no sacroiliac changes were found in cases in which the lesion was confined to the thoracic or cervical vertebrae. In cases of unilateral involvement of the sacroiliac region it may be assumed that the osteosclerotic reaction of one iliac bone was sufficient to offset the disturbed balance temporarily. Eventually, the other iliac bone had to react, also, to restore the weight-bearing capacity of the sacroiliac joints.

In the light of this hypothesis, the sacroiliac findings are not produced by Marie-Strumpell's spondylitis but merely reflect the occurrence of a pathological process immobilizing the lumbar spine. In other words, they do not represent a lesion but a reaction. The diagnostic value of the sacroiliac reaction becomes clear when it is compared to another reaction which has proved of value in the diagnosis of Marie-Strumpell's spondylitis, namely, the sedimentation test. The increased sedimentation of the red blood cells indicates the

presence of an inflammatory process in the body, while the increased calcium content in the sacroiliac region indicates the presence of an immobilizing process in the neighborhood of the joints. The increased sedimentation rate can be likened to the increased temperature, the sacroiliac reaction to the "*defense musculaire*" in appendicitis. Though not a mirror, as an indicator of certain pathological processes in the lumbar spine, the sacroiliac reaction is a very important aid in the diagnosis of Marie-Strümpell's spondylitis. The diagnosis, however, can be regarded as definitely established only when, in addition to the sacroiliac findings, pathological changes are also demonstrated in the intervertebral joints, the primary site of the disease.

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# Solitary Cyst of the Calcaneus<sup>1</sup>

LT COL BENJAMIN COPLEMAN, M C, A U S, MAJ MARINO F VIDOLI, M C, A U S,  
and MAJ FRANCIS J CRIMMINGS, M C, A U S

SOLITARY BONE cyst of the calcaneus is a rare lesion. Sobel (8) and B  cl  re (1) each presented a proved case in 1936. Smith (7), in 1930, reported a case which was not operated upon. This he believed was "either osteitis fibrosa, or, rather, a mere architectural peculiarity," and not to be considered as a true bone cyst. Fitts and Mulcahy (4) presented four unproved cases in 1939. Caritat (3) reviewed the literature to 1941 and added a proved case. Brailsford (2), in Fig 77 of the second edition of his book, "Radiology of the Bones and Joints," illustrates a typical cyst, which he calls an area of osteoporosis.

We have encountered three cysts of the calcaneus within a short time. Two of the patients have been operated upon. The third case is so characteristic that it has also been included in this study.

**CASE I** A 22-year-old white male was admitted with pain in the left heel. He had noticed the onset of this pain on or about May 8, 1944, and it had gradually become worse, so that walking produced distress. There was no swelling, discoloration or pain on motion of the foot. There was, however, tenderness to palpation. A roentgenogram (Fig 1) showed a rounded cyst-like area, measuring 2.5 cm in diameter, in the lateral aspect of the calcaneus at the junction of the anterior and posterior halves. All other roentgenographic and laboratory findings were within normal limits.

On June 5, 1944, the lesion in the calcaneus was exposed and entered. A unilocular cavity without trabeculations was found. A slightly turbid yellowish fluid was released when the cavity was opened. The lining of the cavity was curetted. Several small bone fragments were sent to the laboratory for study. The fascia, muscles, and skin were sutured. A dry dressing and a plaster boot were applied. Healing was uneventful. The report of a roentgenographic examination made at another hospital on Oct. 9, 1944, stated that the cystic area had almost completely filled in.

Grossly, the specimen consisted of numerous small fragments of cortical and spongy bone. The cortical bone appeared in the form of thin gray plates. The

cancellous bone was fairly soft and easily crushed by the fingers.

Microscopically (Fig 2), the most noteworthy finding was the presence of a large cyst lined by closely packed fibroblasts. In some areas the fibroblasts were flattened, while in others they were swollen and tended to be round. This inner layer of condensed cells was continuous with a looser type of connective tissue consisting of abundant collagenous fibrils and sparsely scattered spindle shaped and stellate fibroblasts. Secondary small cysts, similar to the large one described, were formed in this area. The fibrous tissue was richly supplied with dilated, thin-walled blood vessels. Fresh hemorrhages were encountered in this loose fibrous tissue while, in denser areas, nests of large histiocytes laden with hemosiderin pigment were found. Here and there, singly or in small groups, were multinucleate giant cells in the vicinity of the cysts. The fibroblasts showed transition forms to osteoblasts, which lined numerous irregular trabeculae. These consisted of osteoid tissue, areas of irregular calcification of the matrix, and areas of solid bone. The trabeculae were continuous with cortical bone, which varied greatly in thickness. In the thicker portions of the cortex, the cement lines and the calcification were irregular. Along some trabeculae and parts of the inner surface of the cortex numerous osteoclasts were found. Frequently the trabeculae and the cortex formed a bony encasement of the cyst and were separated from its lumen only by a few layers of fibroblasts.

**CASE II** A 23-year-old white male was admitted on July 28, 1944, with a history of pain in the ankle and heel of four months' duration. The pain was dull and aching in character at the beginning but had become gradually worse until the patient was no longer able to bear weight comfortably.

A roentgenogram (Fig 1) showed an apparently multilocular cystic lesion, measuring about 3 x 6 cm, in the anterior half of the lateral aspect of the calcaneus. All other roentgenographic and laboratory findings were normal.

On Aug. 14, 1944, this region of the calcaneus was exposed through an incision below the lateral malleolus, and the cavity was opened after separating the fascia, muscles, and periosteum. A yellow serous fluid was expelled as the cyst was opened. The cavity was unilocular and partly compartmented.

<sup>1</sup> From the Roentgenologic and Laboratory Services, and the Orthopedic Section, Lovell General Hospital, Fort Devens, Mass. Accepted for publication in September 1945.

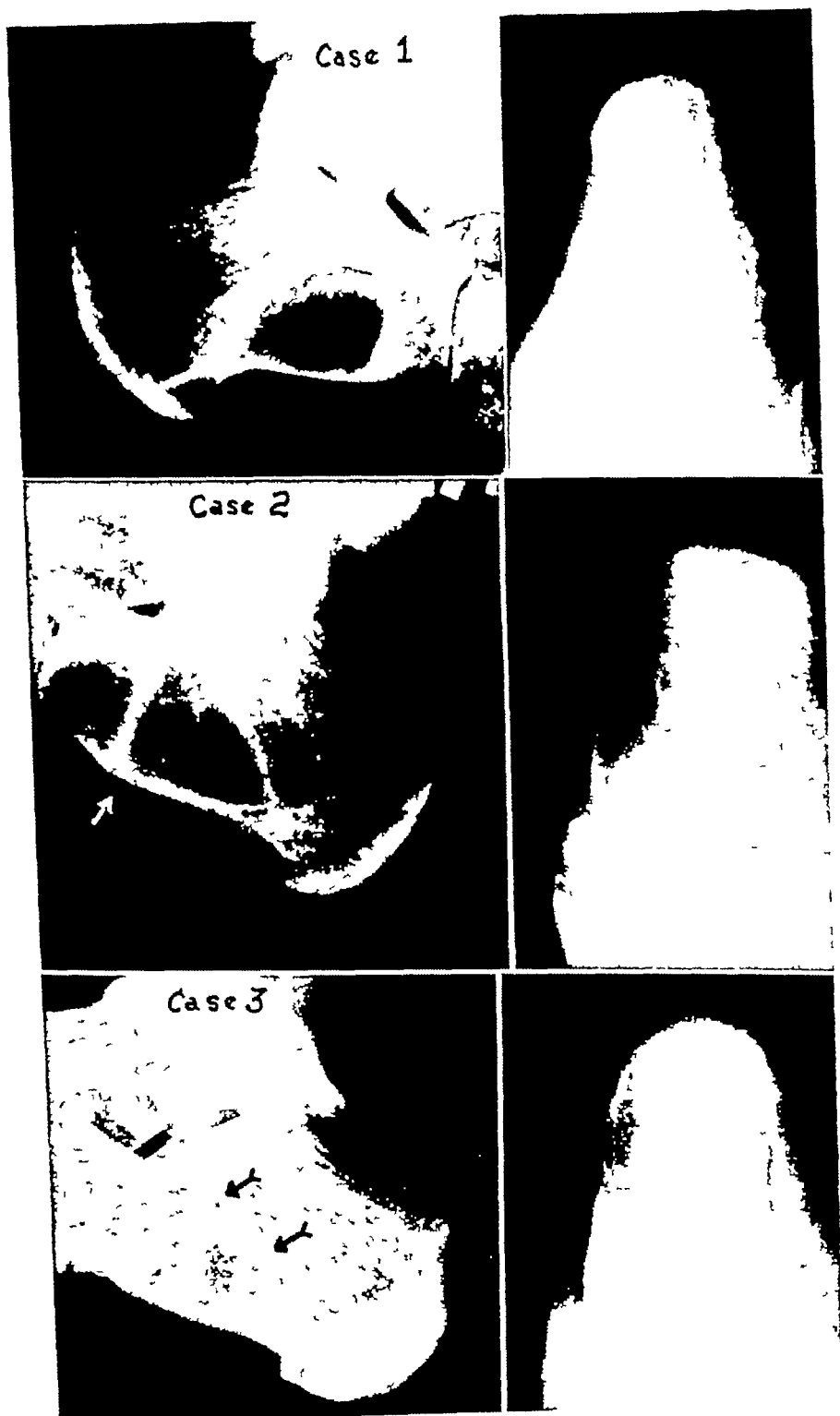


Fig 1 Each cyst appears to start from the oblique trabeculae which delimit the anterior from the posterior half of the bone (black arrows in Case 3) Note the slight expansion of the cyst walls in Cases 1 and 2 (white arrow) The low incomplete septa in Case 2 give the appearance of multilocularity

# Solitary Cyst of the Calcaneus<sup>1</sup>

LT COL BENJAMIN COPLEMAN, M C, A U S, MAJ MARINO F VIDOLI, M C, A U S,  
and MAJ FRANCIS J CRIMMINGS, M C, A U S

**S**OLITARY BONE cyst of the calcaneus is a rare lesion. Sobel (8) and B  cl  re (1) each presented a proved case in 1936. Smith (7), in 1930, reported a case which was not operated upon. This he believed was "either osteitis fibrosa, or, rather, a mere architectural peculiarity," and not to be considered as a true bone cyst. Fitte and Mulcahy (4) presented four unproved cases in 1939. Caritat (3) reviewed the literature to 1941 and added a proved case. Brailsford (2), in Fig 77 of the second edition of his book, "Radiology of the Bones and Joints," illustrates a typical cyst, which he calls an area of osteoporosis.

We have encountered three cysts of the calcaneus within a short time. Two of the patients have been operated upon. The third case is so characteristic that it has also been included in this study.

**CASE I** A 22-year-old white male was admitted with pain in the left heel. He had noticed the onset of this pain on or about May 8, 1944, and it had gradually become worse, so that walking produced distress. There was no swelling, discoloration or pain on motion of the foot. There was, however, tenderness to palpation. A roentgenogram (Fig 1) showed a rounded cyst-like area, measuring 2.5 cm in diameter, in the lateral aspect of the calcaneus at the junction of the anterior and posterior halves. All other roentgenographic and laboratory findings were within normal limits.

On June 5, 1944, the lesion in the calcaneus was exposed and entered. A unilocular cavity without trabeculations was found. A slightly turbid yellowish fluid was released when the cavity was opened. The lining of the cavity was curetted. Several small bone fragments were sent to the laboratory for study. The fascia, muscles, and skin were sutured. A dry dressing and a plaster boot were applied. Healing was uneventful. The report of a roentgenographic examination made at another hospital on Oct 9, 1944, stated that the cystic area had almost completely filled in.

Grossly, the specimen consisted of numerous small fragments of cortical and spongy bone. The cortical bone appeared in the form of thin gray plates. The

cancellous bone was fairly soft and easily crushed by the fingers.

Microscopically (Fig 2), the most noteworthy finding was the presence of a large cyst lined by closely packed fibroblasts. In some areas the fibroblasts were flattened, while in others they were swollen and tended to be round. This inner layer of condensed cells was continuous with a looser type of connective tissue consisting of abundant collagenous fibrils and sparsely scattered spindle shaped and stellate fibroblasts. Secondary small cysts, similar to the large one described, were formed in this area. The fibrous tissue was richly supplied with dilated, thin-walled blood vessels. Fresh hemorrhages were encountered in this loose fibrous tissue while, in denser areas, nests of large histiocytes laden with hemosiderin pigment were found. Here and there, singly or in small groups, were multinucleate giant cells in the vicinity of the cysts. The fibroblasts showed transition forms to osteoblasts, which lined numerous irregular trabeculae. These consisted of osteoid tissue, areas of irregular calcification of the matrix, and areas of solid bone. The trabeculae were continuous with cortical bone, which varied greatly in thickness. In the thicker portions of the cortex, the cement lines and the calcification were irregular. Along some trabeculae and parts of the inner surface of the cortex numerous osteoclasts were found. Frequently the trabeculae and the cortex formed a bony encasement of the cyst and were separated from its lumen only by a few layers of fibroblasts.

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Author	Age	Sex	Operation	cyst	The duration of the symptoms is usually short
Sobel	15	M	+		
Béclère	Not stated		+		
Smith	53	M	-		
Fitte and Mulcahy	14	M	-		
	28	F	-		
	32	M	-		
	32	M	-		
Carlat	26	F	+		
Copleman, Vidoli, and Crimmings	22	M	+		
	23	M	+		
	26	M	-		

## ROENTGENOGRAPHIC DIAGNOSIS

Characteristically, there is a large, sharply margined translucent area in the anterior half of the calcaneus (Fig 1). The cyst is situated in the lateral portion

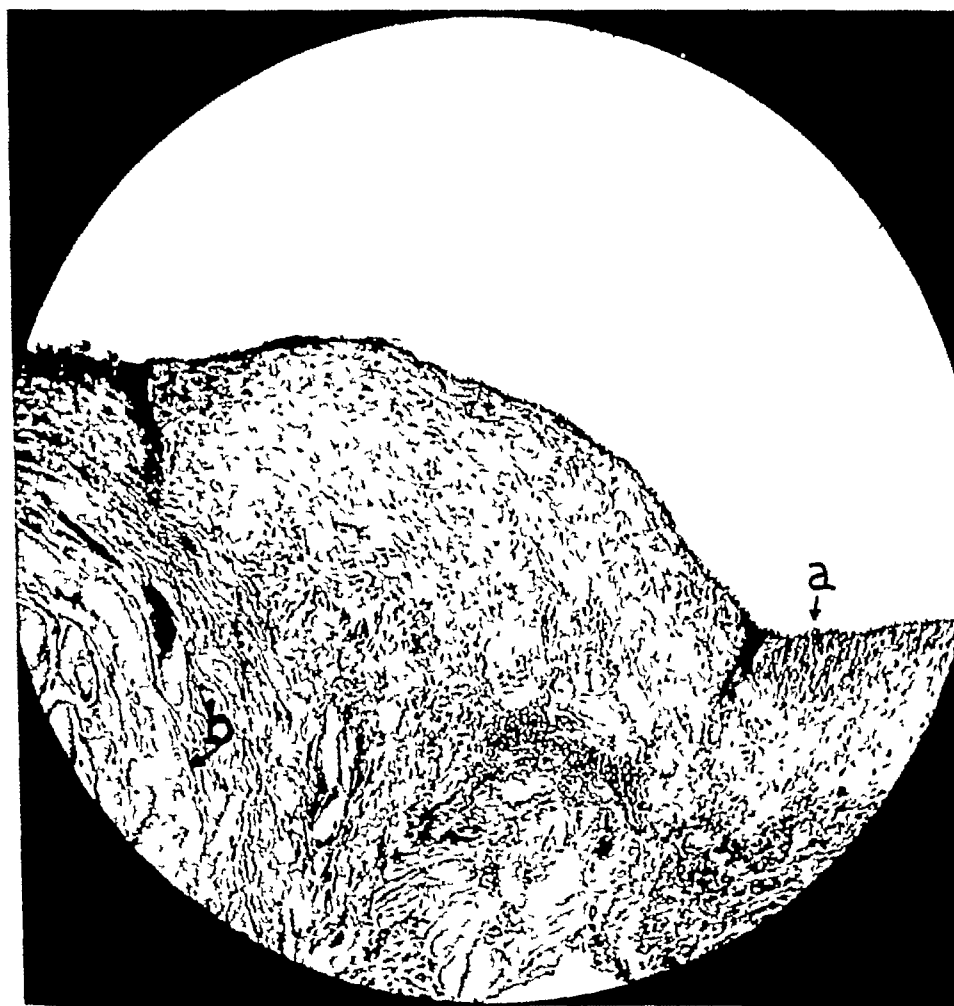


Fig 3 Case II Cyst wall showing tendency to palisading of nuclei (a) Bands of osteoid tissue are seen at the lower left (b)

Most of the patients have been young adult males. The age range is from 14 to 53. Almost all of the patients complained of pain on walking. The cyst was an incidental finding in our third case. The physical examination in these patients is not revealing except for varying degrees of tenderness on palpation over the site of the

of the bone, abutting upon, and sometimes expanding, the inferior and lateral cortex. In almost all of the cases, the cyst has been large enough to reach and extend along the subastragalar cortex, but no expansion has occurred at this site. Unlike the solitary cysts of the long bones, the calcaneal lesions take the form of truncated pyra-

by incomplete septa, which appeared as low ridges. These were rongeuired away and the lining was curried. The muscle fibers were then coapted with No. 40 cotton, and the skin with silk sutures. A dry dressing and a plaster boot were applied. Healing was uneventful.

Grossly, the specimen consisted of about two dozen fragments of spongy bone, mixed with thin plates of gray cortical bone, aggregating a bulk 2.0 cm in diameter.

were found (Fig. 3). Occasionally, bone trabeculae were separated from the lumen of the cyst only by a narrow zone of condensed fibrous tissue.

**CASE III** A 26-year-old white male was admitted to the hospital one week after his induction into the Army. He gave a history of the onset of a fungus infection of his right foot about one month before. An ulcer was present at the plantar aspect of the base of the 4th toe and another on the dorsum

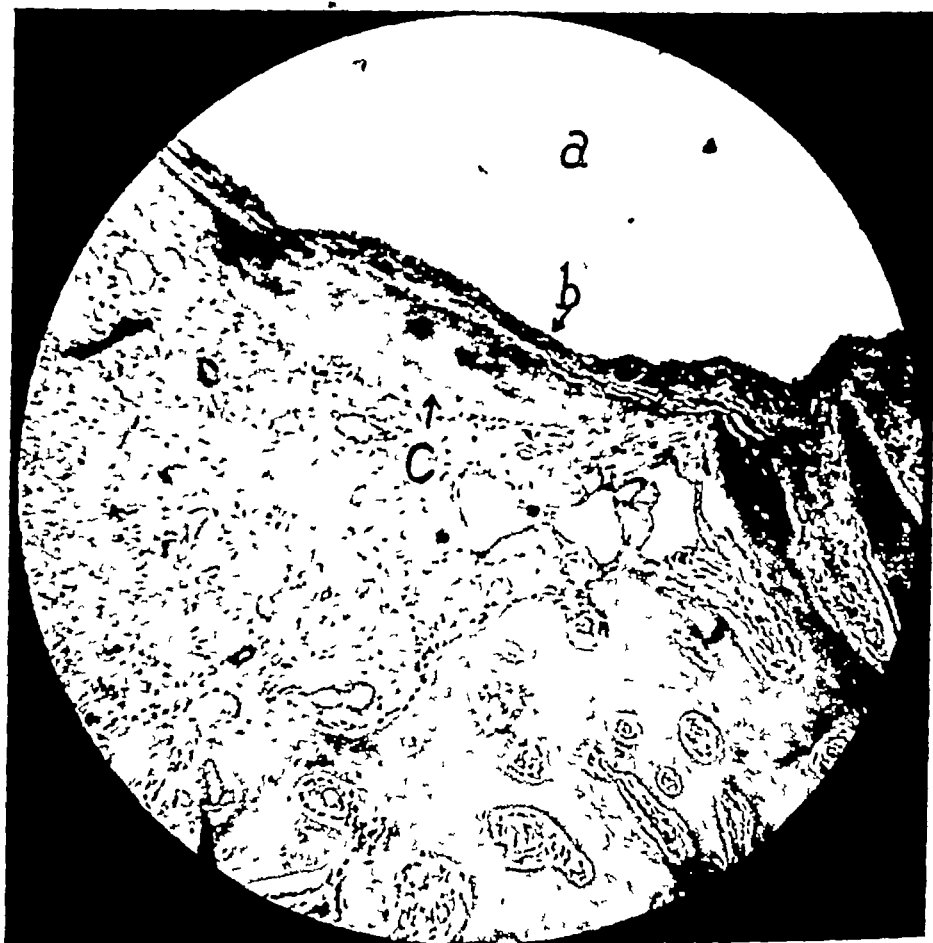


Fig. 2 Case I. Cyst cavity (a) lined by dense fibrous tissue (b) and partly encased by bone trabeculae (c).

The fragments consisted of cortical and spongy bone and of a mixture of dense fibrous connective tissue, osteoid tissue, and bone trabeculae. On the surface of some fragments could be seen a layer of collagenous fibrous tissue of varying thickness which delimited a large cyst. Frequently, the fibrous tissue was more cellular and appeared condensed near the surface. Here and there the nuclei tended to assume a palisade arrangement. In the deeper layers bands of osteoid tissue and bone trabeculae

of the foot. A roentgenogram (Fig. 1) revealed a cystic lesion in the calcaneus, measuring about 2.5 cm in diameter. All other roentgenographic and laboratory findings were normal. Because of the presence of infection and the absence of complaints referable to the cyst of the calcaneus, no operation was performed.

The following table briefly summarizes the cases seen and reviewed by us.

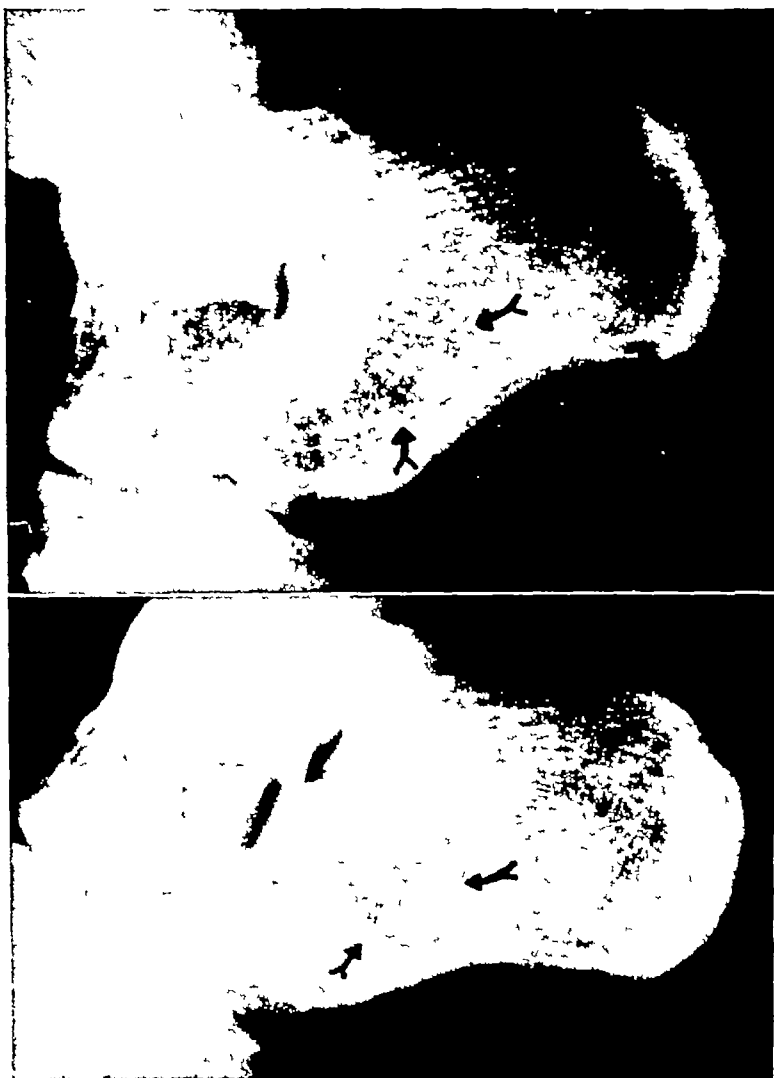


Fig 4 Two normal bones show the slight irregularity of the middle group of mixed trabeculae (arrows) which may be implicated in the development of a cyst

prominence on its inner wall. The presence of these ridges tends to create the roentgenologic appearance of multilocularity. The cysts appear to start at the junction of the anterior and posterior halves of the bone and extend anteriorly. In each of our three cases the cyst was located beneath the lateral cortex. The cysts are filled with a yellowish or serosanguineous fluid. In one of the cases in the literature the cyst contained three small sequestra.

The appearance of all of the published cases is identical in almost all details except size. By means of the tangential view

we have been able to demonstrate the lateral position of the cysts.

#### SUMMARY

1 Nine cases of solitary cyst of the calcaneus have been reported or illustrated in the literature. Of these, three have been operated upon. We have added three cases, two of which have come to operation.

2 The cyst is unicameral and is always seen in the anterior half of the body of the calcaneus. In our cases, and probably also in the others, the lesion has been situated in the lateral aspect of the bone. All of the

mids, the posterior margin lying parallel with the long trabeculae of the posterior half of the bone. This margin appears to fall in almost exactly the same place in every case. The differences in size and shape of the cysts seem to depend on the extent of enlargement from this base in an anterior direction.

Occasionally, the cyst appears to be multilocular (Fig 1, Case 2), but at operation the trabeculation has been found to be due to ridges or low septa. This finding has been described by Jaffe and Lichtenstein in cases of solitary cyst in the long bones.

In the case reported by Caritat (3), three small fragments of dense bone were found loose in the cyst cavity.

All of the cases show roentgenographic features which are so much alike that, once recognized, they seem to make operative proof unnecessary for the acceptance of the diagnosis.

#### PATHOGENESIS AND PATHOLOGY

Mikulicz' contention that solitary bone cyst is a disease entity has received the support of Jaffe and Lichtenstein (5). He believed that its predilection for young subjects and for regions of active growth in the long bones suggested that it represents some local disturbance of bone growth and development. He believed further that it represents a local post-traumatic dystrophy. The theory that the calcaneal lesions may be solely due to the stress of walking or running is attractive, but against this are the rarity and unilaterality of the lesions.

It is striking that all of the cases seen or reviewed by us have occurred in the same location in the bone. In view of the frequent occurrence of simple fractures at the junction of the anterior and posterior halves of the bone, it is probable that this region may be one of greatest stress. It is difficult to escape the impression that mechanical factors may be responsible for the formation of these cysts.

Lenormant (6) found that the calcaneus is a spongy bone reinforced by three kinds

of trabeculae. The posterior trabeculae extend downwards and backwards, the anterior group extend in the reverse direction, and the third group is a combination of the other two (Fig 4). There are many variations in the prominence of the third, mixed group. It may be that one of the large intertrabecular spaces may expand to form a cyst under proper stimulation. As far as can be determined, the development of the calcaneus is no more rapid in this region than in any other.

The gross and microscopic features of these cysts are exactly the same as those observed in the solitary cysts of the long bones described by Jaffe and Lichtenstein. The microscopic features which characterize these lesions are typically those described for the tissue obtained from our Case I. For greater detail, the paper of Jaffe and Lichtenstein should be consulted. These authors state that such lesions should not be regarded as a healing phase of a giant-cell tumor, or as related to fibrous dysplasia or osteitis fibrosa cystica, since there is no histologic proof to warrant such suppositions. Occasionally, in one part of a microscopic section it is impossible to differentiate between osteitis fibrosa cystica and a simple bone cyst. Examination of multiple sections, however, should leave no doubt as to the identity of the lesion.

#### TREATMENT

As with cysts in the long bones, surgical entry and curettage will produce healing. Bone chips may be inserted at the time of operation, but this is not necessary for a cure.

#### DISCUSSION

A solitary unicameral cyst of the calcaneus does not appear to differ from a similar lesion in any other bone in either the gross or microscopic features. It is a rare lesion which occurs in the same place in every case seen or reviewed by us, namely, the infero-lateral aspect of the anterior half of the bone.

The cyst consists of a single chamber, which may show ridges of more or less

# Pulmonary Torulosis<sup>1</sup>

LT COL JOHN B HAMILTON, M C, A U S, and MAJ GILMAN R TYLER, M C, A U S

ACCORDING TO Strong (10), the genus *Torula* consists of an "ill-defined group of yeast-like fungi with pathogenic properties in which the organisms reproduce only by budding, do not produce mycelium or endospores, and do not ferment carbohydrates. They rarely if ever cause lesions of the skin, but appear to have definite affinities for the tissues of the central nervous system and the lungs, though they may produce destructive granulomatous lesions in other organs of the body. The respiratory tract is regarded as the probable portal of entry.

"Freeman (1931) collected a number of cases of central nervous system involvement, which suggested neoplasm or encephalitis, but were associated with the presence of yeast-like organisms, *Torula histolytica*.

"Dodge has called this organism *Cryptococcus histolyticus*."

## REVIEW OF LITERATURE

Levin (6), in 1937, reviewed 60 cases of *Torula histolytica* infection of the central nervous system. In 9 of these cases, lung involvement was also reported, 8 of the 60 cases were of generalized torulosis, in one of these the lung was apparently not involved. Thirty-seven of the 60 cases were diagnosed antemortem, but in no instance was the diagnosis made from the lung lesion.

Binford (1), in 1940, supplemented Levin's collected series with a summary of 14 additional cases reported in the literature, in 5 of which either the organism or a *Torula* granuloma was found within the thoracic cage.

Reeves, Butt, and Hammack (8), in 1941, added 6 more cases, bringing the total number collected to 80. In one of their patients, seen because of symptoms referable to the central nervous system, a

large *Torula* granuloma was found in the lung and the diagnosis was made from purulent fluid aspirated from the chest. Treatment was with potassium iodide, sulfapyridine, and undenatured *Torula* antigen No 1 (Krueger), in April 1940, two and one-half years after the onset of symptoms, the patient was still living, though organisms were obtainable from the spinal fluid. During this time there had been noteworthy regression of the pulmonary lesion.

In 1943 Burger and Morton (2) again reviewed the literature, collecting about 100 cases, to which they added 4 cases of their own. They did not report the incidence of lung involvement in the isolated cases published (and reviewed by them) since Reeves, Butt, and Hammack's article (8). One of their own patients was found to have "chronic bronchitis and bronchiectasis, confluent lobular pneumonia with bronchogenic abscesses, right lower lobe." Otherwise, no evidence of lung involvement was demonstrated in their 4 cases.

Lung involvement alone is rare, having been reported in one case by Sheppe (9) (though the central nervous system was not examined postmortem) and in one case by Hardaway and Crawford (4), in which during fifteen months' observation no central nervous system symptoms developed, though a roentgenogram of the chest showed persistent parenchymal involvement.

Patients with *Torula histolytica* infection, either generalized or of the central nervous system, not uncommonly have pulmonary involvement. One such case, with reproductions of roentgenograms of the chest, is reported by Reeves, Butt, and Hammack (8). The diagnosis in this case, even though the central nervous system was involved, was made from the chest lesion as mentioned above.

Changes in the lungs demonstrable on

<sup>1</sup> Accepted for publication in July 1945



cysts seem to start at the junction of the anterior and posterior halves of the calcaneus and extend anteriorly as they grow

3 The patients are most commonly young adult males. Pain on walking or standing and local tenderness are usually the only symptoms

4 The cyst may originate as a localized dysplasia resulting from multiple small traumata

5 Cure may be expected after curettage

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reproductions of roentgenograms of the chest. Since one of us was a consultant in that case and it has a direct bearing on the diagnosis in the case to be presented, we believe that a brief summary, with reproductions of selected roentgenograms, is worth while.

### CASE REPORTS

**SWANSON AND SMITH'S CASE II** On Dec 12, 1941, a robust white male, age 36, who appeared to be in excellent health, was rejected for service in the Army because of a triangular opacity in the right lung (Fig 1) with its apex in the hilum and its base extending to the periphery from the level of the first to the third ribs anteriorly. About four months later (Fig 2), *Torula histolytica* was cultured from the sputum and gastric contents at Duke University Hospital. Following massive doses of potassium iodide, chemotherapy, and the administration of an autogenous vaccine, the size of the pulmonary lesion diminished (Fig 3). Regression continued and on May 29, 1943, the infiltration measured only about 2 cm in diameter (Fig 4). At that time spinal fluid was reported normal in all respects.

In June 1942, pain in the neck and headaches developed. These recurred intermittently until March 1943, when they became more severe and signs of a cerebellar tumor became evident. At that time the spinal fluid pressure was 350 mm. Examination of the fluid showed a cell count of only 6 cells per cubic millimeter, the protein measured 184 mg per cent, sugar 89 mg per cent, cultures were negative for *Torula*. At operation, a large granuloma was found in the right cerebellar tonsil. The following August the patient died.

**Autopsy** There was a tumor projecting from the right cerebellar hemisphere. The following findings were reported by Swanson and Smith (11): "Serial sections of the brain revealed no other gross lesion and no evidences of meningitis other than mild thickening of the arachnoid over the base of the brain."

"Examination of the viscera showed no significant lesions except in the lungs and spleen. Cysts similar to those of the brain were present in the upper lobe of the right lung, small cysts were seen in the spleen on microscopic examination."

**Comment** A diagnosis of *Torula* infection was made from studies of the sputum prior to the onset of symptoms referable to the central nervous system. Although the pulmonary lesion regressed after treatment, central nervous system symptoms developed and progressed. Freeman and Weidman (3), as reported by Burger and Morton (2), divided the disease

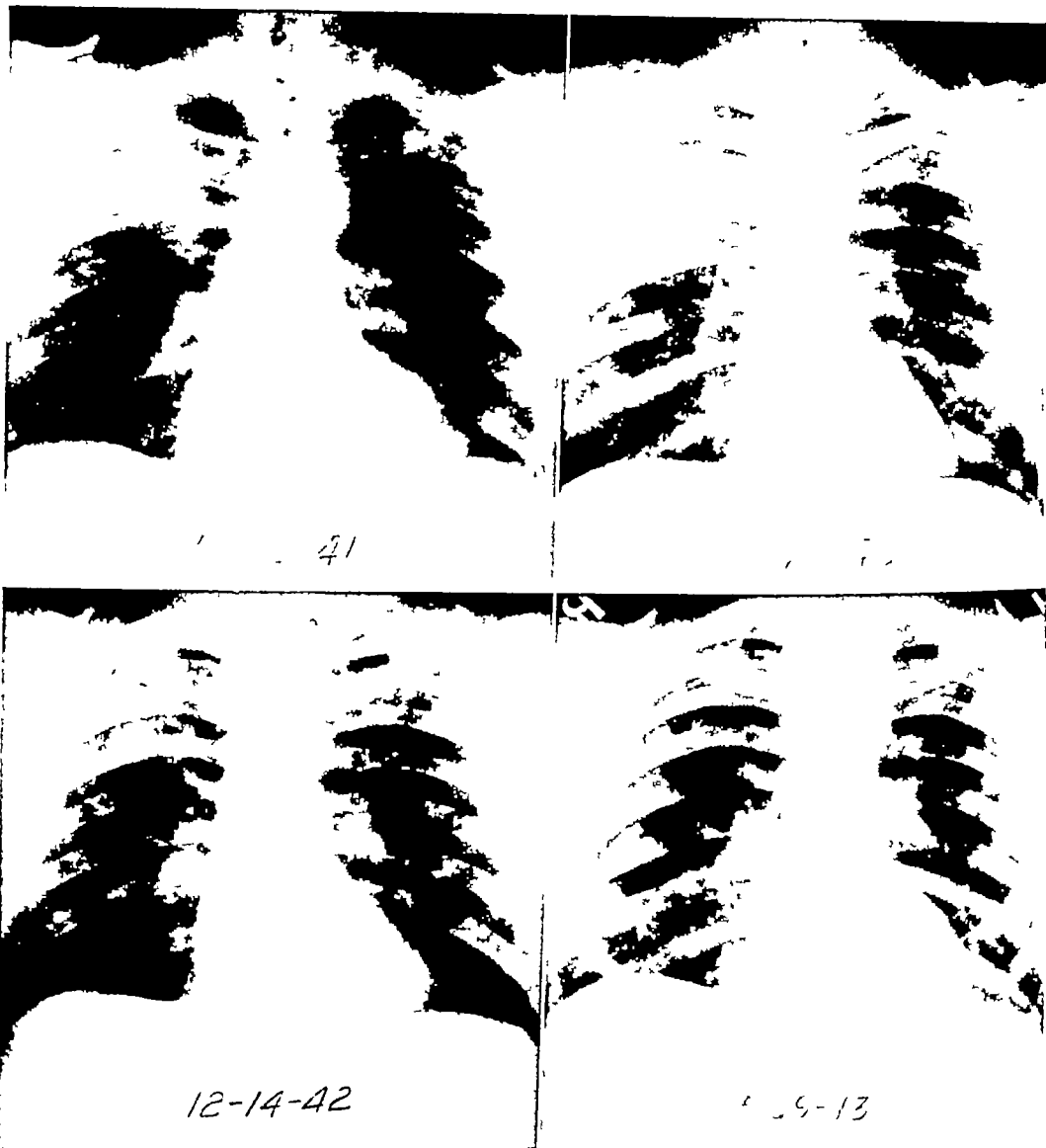
into three types, the third of which is described as "an embolic form, with deeply placed lesions lying chiefly in the gray matter," which is believed to account for the absence of positive findings in the spinal fluid.

**AUTHORS' CASE** A white female, age 24, member of the WAC, had a final type physical examination for military service on Nov 25, 1942, in Los Angeles, Calif. The report on a chest roentgenogram at that time was "No pathology noted." Following basic training in Des Moines, Iowa, and in Kansas City, Mo., she was assigned to duty in Florida in May 1943.

She enjoyed good health until July 12, 1943, when pleuritic pain occurred in the left lower chest, posteriorly. This symptom persisted, and nine days later, on hospitalization at a station hospital, a roentgenogram (Fig 5) revealed a rounded opacity in the upper portion of the left lower lobe. This had the characteristics of an inflammatory lesion. The only positive clinical findings at that time were mild fever of 99.6° and suggestive bronchial breathing over the involved area. The chest pain rapidly subsided and on July 27, 1943, the patient was discharged to duty. She was followed as an outpatient but remained asymptomatic.

On Sept 11, 1943, a progress chest roentgenogram revealed an increase in the size of the lung lesion and the patient was readmitted to the hospital for bronchoscopic examination. This revealed no unusual findings, but a mild, non-productive, persistent cough developed. Except for a white cell count of 10,200 with a normal differential, laboratory studies, including sputum examinations for acid-fast organisms, were negative. Further study was deemed indicated and on Sept 24, 1943, the patient was transferred to an Army General Hospital with the diagnosis of "unresolved atypical pneumonia."

Physical examination at this hospital was negative except for slight increase in breath sounds over the left lower chest, posteriorly. Laboratory studies, including blood cultures, sputum examination for acid-fast organisms and fungi, serum protein, blood NPN, and sugar determinations, a glucose tolerance test, cholesterol determination, and a basal metabolism test, all gave normal findings. The Kahn test was negative. On Sept 25, 1943, the blood count was as follows: red cells 4,800,000, hemoglobin 96 per cent, white cells 15,000 with a normal differential count. The sedimentation rate was 8 mm total in one hour. On Oct 6, 1943, the white blood count had dropped to 8,600, with a normal differential count, and the sedimentation rate was still normal at 2 mm total in one hour. A chest roentgenogram on Sept 27 showed that the lung lesion now apparently contained multiple excavations (Fig 6). The forty-eight-hour reading of a tuberculin patch test (Lederle) on Oct 30 was negative.



Figs 1-4 Case of Swanson and Smith

Fig 1 12-12-41 The patient was entirely asymptomatic and the finding was incidental, being discovered on examination for the Army. Note the triangular opacity on the right extending from the hilar zone to the periphery in the upper lobe.

Fig 2 3-23-42 The patient was still asymptomatic.

Note the increase in the size of the area involved.

Fig 3 12-14-42 The patient was still asymptomatic following therapy.

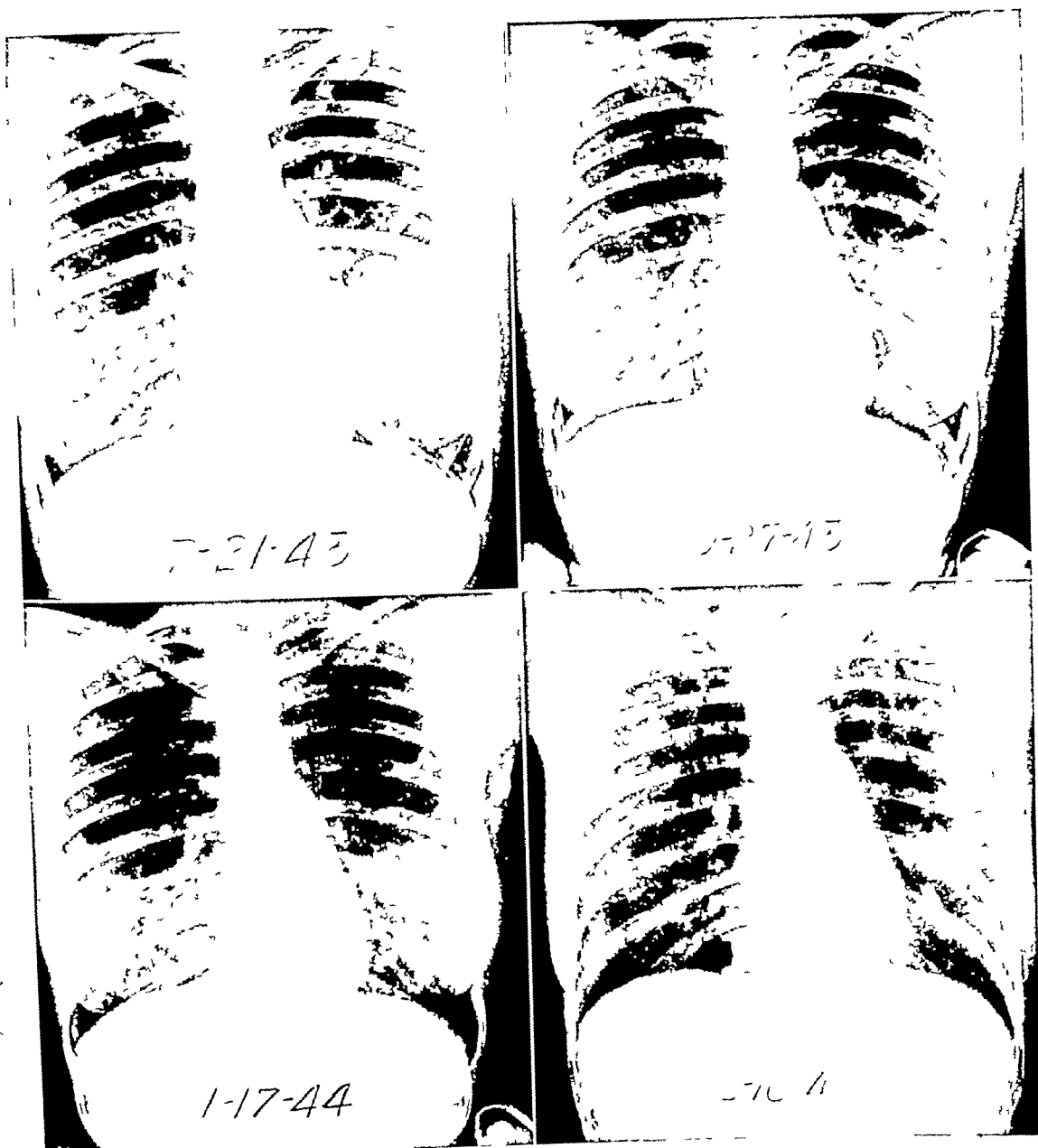
Note the decrease in size of the parenchymal lesion.

Fig 4 5-29-43 Shortly after onset of cerebellar symptoms (but after treatment) the chest lesion had almost completely disappeared.

roentgenograms, while inflammatory in appearance, are not characteristic. Magruder (7) reports pulmonary roentgen findings in one of the 3 cases he has reported, consisting in cotton-like areas of infiltration at the bases and an increase in fibrosis at the right base.

This article is written to add one more case of *Torula* infection involving both the central nervous system and lungs and to call attention to the possibility of diagnosis from chest lesions.

Swanson and Smith (11) in the second case which they reported did not include



Figs 5-8 Authors Case

Fig 5 7 21 43 Nine days after onset of pleurisy the round opacity having the characteristics of an inflammatory lesion in the upper portion of the left lower lobe was demonstrated The patient rapidly became asymptomatic but the finding persisted

Fig 6 9 27-43 Although the patient continued asymptomatic the lesion persisted and the film shows areas interpreted as excavations Bronchoscopy failed to reveal evidence of obstruction

Fig 7 1 17 44 There were still no symptoms but the lesion persisted unchanged in character Note The increased markings in the lower lobes are due to residual lipiodol following bronchography which merely outlined the mass in the parenchyma

Fig 8 2 16 44 Following iodide therapy the regression of the lung lesion is demonstrated Central nervous system symptoms, which had developed progressed apparently unaffected by any form of treatment

The temperature, pulse and respirations continued normal and, except for the mild cough, the patient remained asymptomatic until Nov. 2, when, six days after administration of saturated solution of potassium iodide was begun (5 drops three times daily after meals), chills and fever developed. The drug was discontinued, but for a period of eight days the temperature fluctuated between 99° and 104°. During this period the white blood count increased to 13,100, with 50 per cent neutrophils, 12 per cent lymphocytes, and 8 per cent monocytes, and the sedimentation rate increased to 51 mm total per hour. Following this episode, the white blood count and differential count remained within normal limits and by Nov. 25 the sedimentation rate had decreased to 17 mm total per hour.

Chest examinations on Nov. 8 and 9 revealed clicking rales at the end of inspiration over the left lower chest, posteriorly. Bronchoscopic examination was performed on Nov. 8, and the following report was made: "Inspection of the tracheobronchial tree on the left revealed no evidence of ulceration, fixation, or tumor mass formation. A mild degree of acute inflammatory reaction was noted around the orifice of the left upper and lower lobe bronchi. An aspirating tube was passed into the second divisions of both the upper and lower lobe bronchi and these divisions were found to be patent. There could be demonstrated no direct or indirect evidence of bronchial obstruction on this examination." Following bronchoscopy, the patient appeared to improve, her cough practically disappeared, and the temperature remained essentially normal. On Jan. 10, 1944, she complained of mild headache, but examinations, including retinoscopy, were normal, and on Jan. 20 she was discharged to limited duty, for observation.

Six days later the patient was readmitted to her station hospital, complaining of severe headache, vomiting, and generalized aching. Spinal punctures on Jan. 29 and 31, 1944, revealed an increased pressure of 360 and 380 mm of spinal fluid, which grossly appeared clear. Microscopic examinations were reported as showing a marked increase in white cells, mainly lymphocytes. Spinal fluid protein was 30 mg and sugar 57 mg. Symptoms rapidly increased, including severe headache, vomiting, blurred vision, and diplopia. Examination revealed bilateral papilledema and a diminished right biceps reflex. On Feb. 8, the patient was transferred back to the Army General Hospital in a semicomatose condition, with the diagnosis of 'lung malignancy with metastases to the brain.'

Shortly after readmission to the General Hospital, on the basis of the clinical course and roentgen findings, a presumptive diagnosis of *Torula histolytica* infection involving the pulmonary and central nervous systems was made. On Feb. 9, 1944, a ventriculogram showed no abnormalities in the outline of the ventricles. Although the spinal fluid was under increased pressure, it showed no gross ab-

normalities when removed from the ventricles. A spinal puncture on Feb. 12 registered greatly increased pressure, 600 mm, the fluid was clear and contained 180 cells per cubic millimeter, 160 of which were interpreted as lymphocytes. Spinal fluid cultures, however, revealed a budding yeast organism, typical of *Torula histolytica*. The fluid showed 47 mg of sugar, 91.4 mg of protein per 100 cc. A test for globulin was positive, the Wassermann reaction was negative but the colloidal gold curve was 4443321000. Other laboratory studies, including blood counts and urinalyses, were normal.

Physical findings at this time were few—paralysis of the right internal rectus, markedly diminished corneal reflexes, suggestive Babinski signs bilaterally, and mild hypersensitivity of the entire right side. The patient remained semicomatose, complaining of headache and occasionally vomiting.

Saturated solution of potassium iodide, 3 minims three times daily, was given, and the dosage was eventually increased to 15 minims three times daily. Eight days after admission, one week after institution of potassium iodide therapy, a chest roentgenogram (Feb. 16) showed partial clearing of the lung lesion (Fig. 8). No clinical improvement occurred, however, and sulfathiazole was given, followed by penicillin therapy. A total of 110,000 units was given—10,000 units intrathecally in divided doses of 5,000 units each and 100,000 units intramuscularly, 10,000 units being given every three hours.

Bacteriological assays demonstrated that the organism grew vigorously in cultures containing all of the available sulfa drugs and even more vigorously in penicillin cultures, subcultures grew without difficulty in dilutions from 1:100,000 to 1:10,000 acriflavine. All medication except potassium iodide was therefore discontinued.

Nine days after admission the patient suffered a severe convulsion, followed by increased difficulty in swallowing and generalized muscular twitching. The spinal fluid pressure progressively diminished and punctures were discontinued on the twelfth day after admission. Laboratory studies at this time revealed an 85 per cent hemoglobin and 4,110,000 red blood cells. There was a leukocytosis of 13,800 with 88 per cent polymorphonuclear neutrophils. The sedimentation rate showed an increase, 55 mm fall per hour, and the clinical course was progressively and steadily downhill. The neurological findings increased, pulse was rapid, respirations became Cheyne-Stokes in character, and death ensued on Feb. 27, 1944, the nineteenth day after the patient's second admission and seven months after the onset of symptoms. Just prior to death, the pulse was recorded as 160 beats per minute and the temperature was found to be 107°.

**Autopsy.** Gross findings at autopsy included: pleurisy, adjacent to the upper portion of the left lower lung. In the upper portion of the left lower lobe was a hemorrhagic circular lesion, approximately 5 cm in diameter, which on section showed

monary torulosis should be borne in mind when there is a persistent asymptomatic or relatively asymptomatic parenchymal lesion which has inflammatory characteristics and which is resistant to diagnosis by ordinary laboratory procedures, especially if the patient is showing no evidence of a malignant neoplasm. Our experience suggests that neither penicillin, sulfathiazole, nor acriflavine has any value in the treatment of this condition.

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irregular cavitation, was loculated and filled with a reddish-brown gelatinous necrotic material. The lesion was not sharply demarcated from the lung, and in the surrounding lung tissue there were irregular foci of gray consolidations resembling bronchopneumonia. Smears and cultures of the necrotic material revealed *Torula histolytica*.

The exterior of the brain grossly appeared normal except for evidence of the recent ventriculogram in the occipital region but, after fixation in formalin, many minute cysts were found in the mid-brain, especially on the left side, and there were two sharply circumscribed, firm, semitranslucent areas in each occipital lobe, measuring 8 mm in diameter.

Microscopic examination of the lung revealed innumerable organisms typical of *Torula* in the central portion of the hemorrhagic region described above. There was considerable necrosis in this area, but the inflammatory response was not striking, although there were increased vascularity and lymphocytic infiltration. The adjacent lung tissue showed characteristic areas of bronchopneumonia, the alveoli containing fibrin and leukocytes.

Sections of the areas in the occipital lobe showed circumscribed regions of complete loss of brain substance with only strands of supporting stroma remaining. Scattered through these areas were innumerable round and oval budding forms typical of *Torula*. As in the lung, the inflammatory reaction was very slight, there being only perivascular cuffs of lymphocytes adjacent to the above-described areas. Sections of the mid-brain showed similar changes. The meninges likewise showed only a slight inflammatory reaction, containing lymphocytes and a few plasma cells with rare multinucleated giant cells. The organisms were also seen scattered throughout the meninges and occasionally were found to have a very pale-staining irregular deposit of capsular material.

Nothing remarkable was found in the other organs.

The final pathological diagnosis was pulmonary torulosis with metastasis to the central nervous system.

#### DISCUSSION

With the earlier case in mind, after the onset of symptoms referable to the central nervous system, a presumptive diagnosis of *Torula histolytica* infection was made prior to laboratory confirmation. The basis for this diagnosis was the presence of a lesion in the lung parenchyma with inflammatory characteristics, which for half a year changed little in appearance and was for the most part asymptomatic, had resisted diagnosis by laboratory tests, and was followed by symptoms referable to the

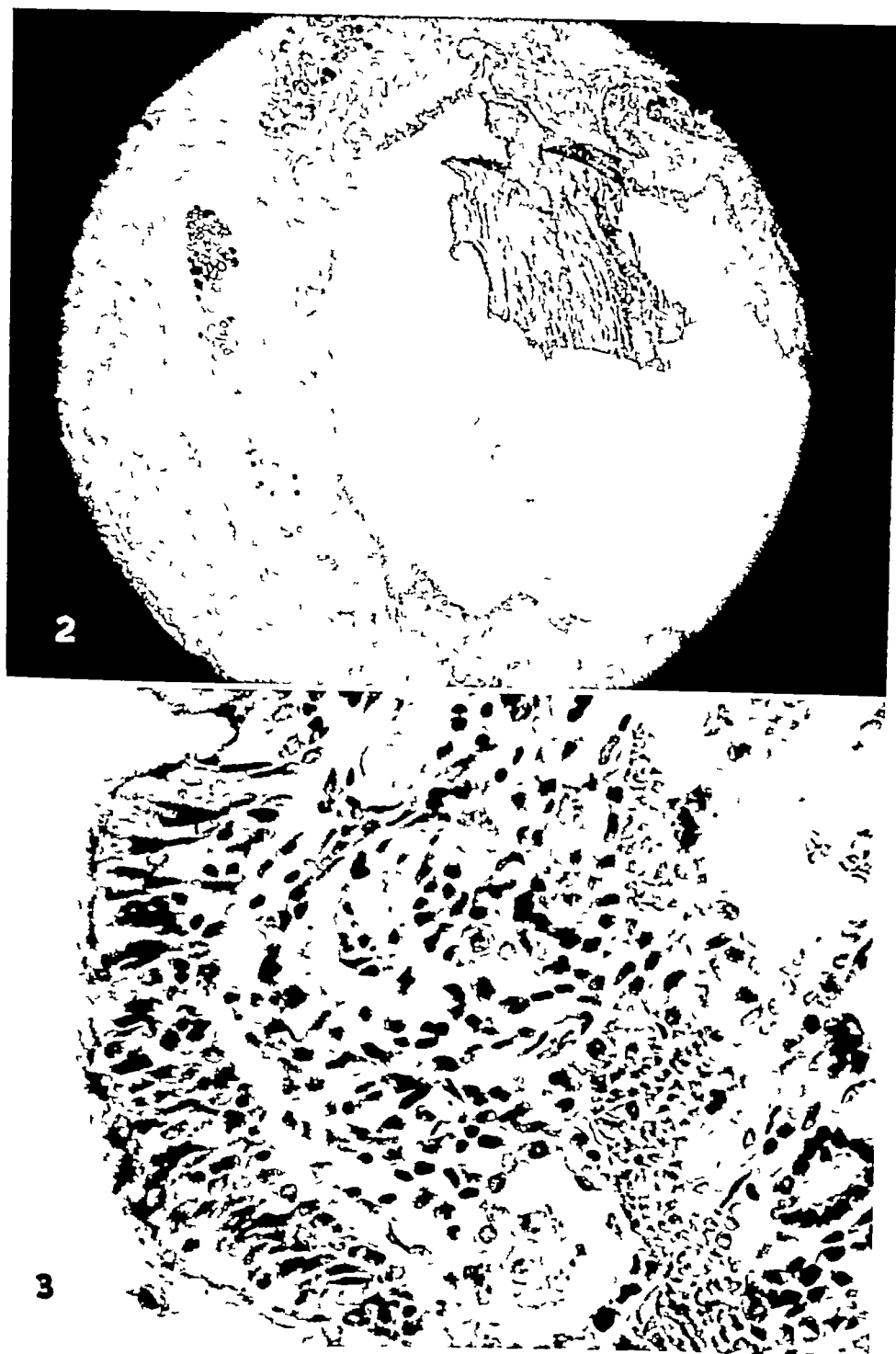
central nervous system. The course of the disease had not been suggestive of a malignant growth. It is noteworthy that the lesion in the chest receded following iodide therapy but that the central nervous system involvement resisted all forms of treatment. It is also worthy of note that the organisms were resistant not only to sulfathiazole but to 110,000 units of penicillin. The organisms flourished *in vitro* in a culture plate in the presence of penicillin and in dilutions of acriflavine. Harford *et al.* (5) have also called attention to the lack of beneficial effects of penicillin in the treatment of *Torula* infection.

The identification of *Torula histolytica* can readily be overlooked by laboratory technicians unfamiliar with the organism. It is important to have the slides reviewed by a pathologist acquainted with this form of yeast-like fungus when the infection is suspected.

In retrospect, it seems not unlikely that the reported increase in lymphocytes in the spinal fluid represented *Torula* organisms and not a real increase in lymphocytes.

#### SUMMARY

Torulosis not infrequently manifests itself by producing pulmonary lesions, which in turn often antedate demonstrable involvement of the central nervous system. These pulmonary lesions are usually asymptomatic or nearly so and may be found either on routine roentgenologic examination of the chest or, as in our case, mild symptoms may call attention to the pulmonary infection. In these cases roentgen findings far exceed those expected from the standpoint of symptomatology. The changes occurring in the lungs, as reported by others, may assume various appearances and are not characteristic of the disease, but usually suggest the possibility of tuberculosis. The lung lesion may precede by many months the onset of symptoms referable to the central nervous system and tend to regress when massive doses of potassium iodide are administered. The possibility of pul-



Figs 2 and 3 Case I Fig 2 shows one of the large cystic cavities Note the coagulated protein within the lumen of the cyst Fig 3 shows the pseudostratified epithelial lining of the cystic cavity



# Congenital Cystic Disease of the Lung<sup>1</sup>

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THE CHARACTERISTIC features of congenital cystic disease of the lung are sufficiently known today so that the diagnosis may be surmised from the clinical history, the physical findings, and especially the roentgenographic picture. The multifarious aspects of the malady may, however, be a source of misinterpretation to the roentgenologist not familiar with them.

Congenital cystic disease of the lung is defined as consisting in intrapulmonary heterotopic spaces (or a single space) whose walls are composed of bronchial lining epithelium and whose fluid content is a product of the bronchial epithelium. The cysts may be single or multiple, with or without communication with a bronchus.

Congenital cystic disease of the lung presents itself in two forms: cystic disease proper and the "fluid cyst." The former is characterized by numerous cystic cavities, which may involve a part of a lobe, a whole lobe, an entire lung, or both lungs. The cysts communicate freely with their respective bronchial branches. Examination of a large series of cases would reveal various stages of transition, from the normal to frankly multiple cystic involvement. Many names have been applied to this form of the disease, as congenital bronchiectasis, honeycomb lung, etc. The following case is illustrative of this type.

**CASE I (Figs 1-3) Preoperative Diagnosis:** Bronchiectasis of right middle lobe. **Postoperative and Pathological Diagnosis:** Congenital cystic disease of right middle lobe.

S. D., a 39-year-old female, entered the hospital on Dec 13, 1943, complaining of pain in the right side of the chest, which had appeared for the first time in 1936. The past history revealed the usual childhood diseases and a right-sided pleurisy in February 1943. The pain was said to be periodic



Fig 1 Case I Iodized oil outlining the dilated bronchus in the right middle lobe and the cystic cavities.

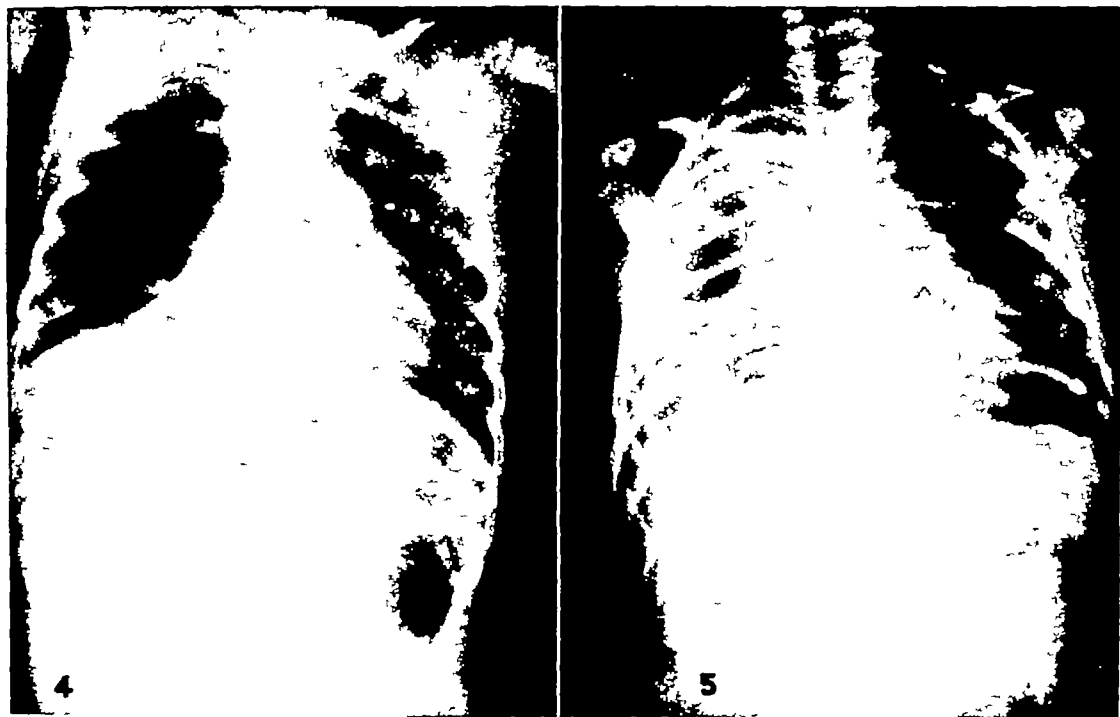
and of constrictive nature, accompanied by a hacking and moderately productive cough. There had been an episode of hemoptysis in 1936.

The blood pressure was 90 mm. Hg systolic and 60 diastolic, hemoglobin 12.5 gm. Examination of the sputum was negative for tubercle bacilli.

Routine fluoroscopic examination of the chest disclosed no evidence of a parenchymatous lesion. The heart and aorta presented no abnormalities, the trachea was in the mid-line. Roentgen studies with iodized oil (Fig 1) showed a sacular dilatation of one of the larger bronchi in the right middle lobe with definite cupping at the bronchial end. The cystic cavities were fairly well outlined.

Lobectomy of the right middle lobe was performed on Dec 21, 1943, by Dr. William Adams and Dr. J. E. Bryant. The pleural surface of the specimen was smooth. The parenchyma was crepitant. The cut surface showed four cavities, varying from 0.5 to 1.0 cm in diameter. The lining epithelium was an even yellowish gray. No fluid was seen. Microscopic sections showed large cystic cavities lined with

<sup>1</sup> From the Departments of Surgery and Radiology, Provident Hospital, Chicago. Accepted for publication in August 1945.



Figs 4 and 5 Case II Fig 4 shows the large cyst replacing the entire right lung The heart and mediastinal structures are not displaced, indicating that the intrathoracic pressure is not greater than the atmospheric pressure. A later film (Fig 5) shows reduction in the size of the cyst The bands of lung tissue forming septa are clearly seen, giving to this solitary cyst a multilocular appearance

normal position (Fig 4) Subsequent roentgenograms demonstrated a significant decrease in the size of the air cyst (Fig 5) Retained secretion was observed on two occasions

*Comment* There is no doubt of the congenital origin of the solitary cyst King and Harris (5), reviewing the development of the lung in the embryo, quote Simpkins, who believes that the bronchi develop from small ramifications of solid endodermal tissue, which become canalized almost immediately They are of the opinion that an unknown process interferes with this canalization, which is resumed in the solid mass of cells distal to the occlusion The normal epithelium assumes normal secretory function, and, because there is no way for the egress of the secretion, a cyst is formed When such a cyst empties its whole content, a pneumocyst is formed

The mechanism of formation and mode of evolution of pneumocysts have been the subject of considerable speculation

That they have bronchial communication is evidenced by their constant air contents Peirce and Dirkse (6) believe that most pneumocysts are acquired They feel that the occurrence of excavation in the lung following a pneumonia or a bronchopneumonia, with a propensity to cyst formation, should make one very cautious in rendering a diagnosis of "congenital cyst" Chronic bullous emphysema is another condition which may present a roentgenographic pattern of multiple air cysts

Two kinds of congenital pneumatoceles present themselves the non-expanding type, in which the air sac does not change in size during respiration (Figs 4 and 5), the expansile form, or "balloon-cyst," which continues to expand, displacing the mediastinal structures and causing impairment of the respiration and circulation Cysts of this latter type are often fatal in spite of treatment

Once the pneumatocele is established,

high columnar pseudostratified to low cuboidal epithelium (Figs 2 and 3). The underlying connective tissue and smooth muscle bundles formed large septa between the cysts.

*Comment.* The case described above corresponds to one of the two forms of congenital bronchiectasis described by Grawitz (1), in which one of the main bronchi constitutes a large cyst, all its collateral branches being dilated and debouching into it. The second variety, much more common, is the telangiectatic bronchiectasis in which the bronchioles are more or less uniformly dilated, giving the typical appearance of the so-called honeycomb lung.

The mechanism that brings about the congenital dilatation of the bronchi is still in the domain of hypothesis. Some believe that atelectasis and a faulty embryologic arrest of the alveolar tissue play a role in the genesis of the condition. Others incriminate congenital syphilis as the underlying factor. Grawitz, and later Parmelee and Apfelbach (2), observed a collection of fluid in the fetal bronchioles. This, they believed, would cause bronchial dilatation. Stoerk (3) and others regard the lesion as neoplastic, since they observed proliferation of epithelial and connective tissue, giving a picture similar to that of fetal adenoma.

There are no characteristic pathologic findings. The close resemblance to fetal lung indicates the origin of these cysts, that is to say, they are the result of faulty embryologic development. The occasional demonstration of associated congenital abnormalities, as bronchial adenoma or abnormal bronchi, the evidence of cystic changes in the lungs of premature infants, favor the congenital theory.

The cysts may be quiescent for years, and the bearer may reach adult life without being aware of the condition. Various underlying processes betray its presence, especially infection from distant foci, chronic sinusitis, and other upper respiratory infection. Rarely a sudden attack of hemoptysis will open the scene. In the vast majority of cases, however, the symptoms are pain and productive cough.

If the cysts are infected, differentiation from acquired bronchiectasis becomes difficult. In the case under discussion, the nature of the bronchial secretion, which was mucoid and odorless instead of being frankly purulent and foul, over a period of seven years, and the location of the pathologic process in the right middle lobe, without involvement of the lower lobe, should have led to a correct diagnosis.

The "fluid cyst" is primarily asymptomatic and appears roentgenographically as a localized area of increased density, with smooth contour. Infection through its wall by microorganisms and the cough reflex, bringing into play the diaphragm and other respiratory muscles, may sweep away the cystic contents, wholly or partially, into the bronchial tree, or, rarely, may cause the cyst to rupture into the pleural cavity, producing a hydropneumothorax or pyothorax.

The following case has been reported elsewhere (4). Here it is considered from a different point of view and roentgenograms not previously published are reproduced. It illustrates the possibility of rupture of the fluid cyst into the bronchial tree, with discharge of its contents, and their replacement by air, giving rise to a pneumocyst.

**CASE II** (Figs 4 and 5). I. S., aged 3 years, entered the hospital Jan. 7, 1935, with symptoms of pleurisy with effusion. The temperature on admission was 103°. The child was born at term and had a normal developmental history except for repeated "colds." On numerous occasions she had expectorated copious amounts of yellow material.

Physical examination showed a well developed child, with slight dyspnea of decubitus. Percussion of the chest revealed dullness over the base of the right side and increased resonance in the right upper third. Mantoux tests were negative.

X-ray examination disclosed a multilocular air sac with almost complete absence of normal lung in the right side of the chest. A band of pulmonary tissue at the right base formed septa and gave to the cyst a multilocular appearance. The pleura could be well outlined from the thoracic wall, and the linear shadows observed throughout the cystic cavity were curved, rather than straight as in cases of pneumothorax. A diagnosis of large solitary multilocular cyst was made. There was no displacement of the heart, and the mediastinal structures were in their

and an inch in length. The outer wall of the cyst was sutured to the intercostal structure, thus marsupializing the cyst. No closure was made.

Following this, the temperature returned to normal and the patient's condition improved, her appetite was better, and the cough and dyspnea disappeared. Roentgenograms made after injection of iodized oil demonstrated a multilocular cyst. The heart was still displaced to the left side (Fig 7).

Microscopic sections of the cyst wall showed a vascular fibrous tissue, with numerous cystic spaces lined with cuboidal or low columnar epithelium among the vascular channels. Scattered in the fibrous stroma were many round cells and some polymorphonuclear leukocytes (Fig 8).

cavity with a fluid level, particularly in children, the possibility of congenital cystic disease of the lung should be kept in mind. Thoracentesis did not alter the course of the disease, but thoracotomy and drainage were followed by dramatic improvement, due to the cessation of the toxemia and disappearance of pressure within the cyst.

The child has developed well but will be kept under observation until she reaches an age when a lung resection may be the method of choice.



Fig 8 Case III Cuboidal epithelium lining the cystic spaces

*Comment* This case is instructive both from the point of view of diagnosis and treatment. It shows that, although the history and physical findings are not pathognomonic of this condition, they may lead the clinician to the diagnosis. The recurrent attacks of a productive cough, the toxemia, the dyspnea and cyanosis, which are respectively the result of infection and intrathoracic changes, are suggestive of congenital cystic disease of the lungs. The case further demonstrates that when the roentgenograms reveal a large solitary

#### CONCLUSIONS

- 1 Three cases of congenital cystic disease of the lung are reported.
- 2 The first type, cystic disease proper, called also congenital bronchiectasis, may be latent for years, until infection leads to its discovery. The patients are mostly adults, and the prognosis is favorable. In the case recorded in this paper, the cysts were confined to one lobe of the lung, and lobectomy was considered the treatment of choice.
- 3 The "fluid cyst" may partially dis-



Figs 6 and 7 Case III In Fig 6 a fluid level is seen within the cystic cavity. The heart is shifted to the left, indicating increased intrathoracic pressure due to a check-valve mechanism. In Fig 7 the multilocular aspect of this solitary cyst is demonstrated with the aid of iodized oil.

why should the sac continue to expand? The explanation commonly accepted is the check-valve mechanism, described by Chevalier Jackson (7), which permits air to enter freely into the cyst without corresponding egress. In the non-expansile form the bronchial opening is large enough to permit both entrance and exit of air. This particular form may be seen in adult life.

The case under discussion is an illustration of a non-expansile type of pneumatocele. The mediastinal structures showed no displacement during the phases of respiration, indicating that the air content was not greater than the atmospheric pressure. The patient was followed in the clinic during a period of one year and showed no distress except for occasional upper respiratory infection.

The following case illustrates the rupture of a cyst into a bronchus.

**CASE III (Figs 6-8)** A R., a Negro girl aged 8 months, was brought to the emergency service on July 3, 1940, because of a coughing episode and temperature elevation to 102° F. After admission, the

patient coughed continuously, with a sudden discharge, by nose and mouth, of a profuse mucoid material. The respiration was rapid, and each expiration was followed by a deep grunt.

The child had been born after a normal labor and cried at birth. She was undernourished, and breath sounds over the right chest were suppressed. The roentgenograms demonstrated a fluid level at the base of the right lung. The heart was shifted to the left (Fig 6).

The red blood count was 3,090,000, hemoglobin 50 per cent, white blood count, 16,150, (polymorphonuclear neutrophils, 61 per cent, lymphocytes 38 per cent, large mononuclears 1 per cent). Urinalysis and other laboratory findings were negative.

Thoracentesis was performed, and 112 c.c. of purulent material were removed. In spite of supportive treatment, the child continued to run a septic temperature, with dyspnea and spasmodic attacks of coughing.

On Aug 13, 1940, an open drainage was performed by Dr. William Adams under local anesthesia. An incision was made over the ninth right rib in the postaxillary line, and about one inch of this rib was removed subperiosteally. An incision was made through the rib bed into the cyst cavity and a large amount of purulent material was aspirated. A piece of the wall of the cyst was removed for microscopic study. Two small rubber tubes were placed in the opening, which was approximately half an inch wide.

# The Normal Lateral Retrograde Pyelogram<sup>1</sup>

MAJ JAMES M DELL, JR, M.C, A U S, and MAJ COLUMBUS H BARNWELL, M C, A U S

THE PURPOSE OF this paper is to present the position of the kidney as found in a series of lateral pyelograms, to determine the normal variation in position, and to assess the effect upon it of slight degrees of rotation. The justification for the study was an attempt to establish a normal that would be of value in determining abnormal forward displacement of the kidney by retrorenal growth or abscess.

The roentgen signs of significance in perinephric suppuration are (1) loss of outline of the psoas muscle shadow, (2) absence of perirenal fat, (3) fixation of the kidney as seen in the upright position, and failure of the kidney to move with deep respiration, (4) scoliosis, indicating muscle spasm, (5) forward displacement of the kidney in the lateral pyelogram as reported by Menville (1).

Philip Shambaugh (2) found 24 cases of puzzling extrarenal masses in the left flank. It was important in these cases to determine whether the mass was intra- or extraperitoneal. If the kidney was displaced, the evidence pointed to an extraperitoneal mass, if the position was normal, the mass was probably intraperitoneal. Lateral pyelograms should be of great aid in this type of case. Forward displacement of a kidney could not be caused by an intraperitoneal mass.

To determine forward displacement, it is essential that we know the normal and its variation. It was with this thought in mind that the present study was made. The cases studied presented a variety of conditions: nephrolithiasis, pyelectasis, caliectasis, enuresis, tuberculosis, pyelonephritis, etc. In each instance retrograde pyelograms were obtained in anteroposterior and lateral recumbent projections. Only one kidney was injected in each case—the down kidney in the lateral film. Five

cases were studied with various degrees of rotation from the true lateral, from 10° to 40° anteriorly and the same posteriorly. Three cases were studied in the recumbent lateral, the 45° from the perpendicular lateral, and the upright lateral positions. The kidneys in these cases showed a rather marked descent in the upright position. A total of 35 patients were studied, in 15 the observations were made on the left kidney, and in 20 on the right.

Thirty-one of the 35 subjects showed the tip of the inferior calyx at a level above the lower margin of the body of the second lumbar vertebra. Twenty-eight of the 31 showed the calices and pelvis within the shadow of the first and second lumbar vertebral body and 3 within the shadow of the twelfth thoracic and first lumbar bodies. Except for one case with a large dilated pelvis, none of the 31 showed any projection of the pelvis or calices anterior to the anterior border of the vertebral bodies. In the one exception, the pelvis extended from the posterior border to a point 3 cm anterior to the anterior border.

Figure 1 (Case I) illustrates the average position in the 31 cases. A composite tracing of the group was made, but there were so many overlapping lines that it was not used. Figures 2-5 show the position in the remaining 4 cases. Tracings are used because of the difficulty in procuring clear prints from the roentgenograms.

Figure 2 is from a case of actinomycosis in the right flank with a draining sinus (Case II). There was a mass in the right flank apparently too far lateral to be connected with the kidney, but retrograde pyelograms were made for confirmation. The lateral pyelogram shows the kidney apparently displaced forward. The patient was operated upon, and a sinus tract was followed to a mass in the abdominal

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charge its contents into the bronchi, in which event the presence of air and fluid, demonstrable on the roentgenogram, will simulate a pleural effusion. Or the entire contents may be evacuated, resulting in a pneumocyst, which must be differentiated from acquired cyst and from pneumothorax.

4 When a check-valve mechanism permits air to enter the lung freely, without corresponding egress, the roentgenogram shows displacement of the heart and mediastinal structures, dyspnea and cyanosis are the most frequent symptoms. If the bronchial opening is large enough to permit both ingress and egress of air, the mediastinal structures are not displaced, and dyspnea and cyanosis do not occur.

5 The prognosis is influenced by two factors: the age of the patient and the presence or absence of complications. Children do not respond well to thoracic surgery, and in them the prognosis is poor. In adults treatment is far more successful. Infection and intrathoracic pressure are

the most serious complications. In their absence the prognosis is more favorable.

6 Treatment consists in supportive measures, thoracentesis, permanent drainage, and lung resection.

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wall composed of hard cartilaginous material. The right kidney was explored and no abnormality was found. The pelvis and calices are seen in the tracing to lie at a low level.

Figure 3 is from a case of bifid pelvis with a pyelectasis (Case III). Note the anterior position of the kidney at this level. This patient was operated upon and an aberrant vessel was severed and ligated. No retrorenal mass was found.

Figure 4 (Case IV) shows the position of the kidney in a case of pyuria due to prostatitis. The pelvis and calices are at a level from the lower quarter of the body of the second to the upper border of the body of the fourth lumbar vertebra. The pelvis and calices of this kidney are anterior to the anterior border of the vertebral bodies. The other kidney in this case occupied the usual level and was posterior to the anterior border of the vertebral bodies. In this presentation the word kidney refers to the calices and pelvis as outlined by the opaque media.

Figure 5 is from a patient with enuresis without demonstrable urinary disease (Case V). This shows the forward position of a kidney located at a slightly higher level than in the three preceding cases. No operation was done in Cases IV and V.

The three cases studied in the recumbent, 45° erect, and erect positions showed the kidney descending an average of 9 cm. As the kidney descends, it lies progressively further forward and the upper pole is rotated posteriorly.

In the more muscular subjects, the kidney was found to lie slightly more anterior, but the difference was not enough to change any of the conclusions from this study.

Ten degrees of forward or posterior rotation will not cause change of position of any consequence. Posterior rotation of the up side will tend to place the kidney of the down side in a more anterior position relative to the spine. Anterior rotation will produce a reverse effect. Rotation can

usually be determined by the relative position of the ribs. Films showing moderate rotation should not be used.

Acceptable films with rotation are those which show the up side ribs not over one inch anterior or posterior to the down side ribs. This is determined from the posterior portion of the ribs. Moderate rotation is any beyond the one inch mentioned above.

#### CONCLUSIONS

A kidney lying between the level of the twelfth thoracic and the lower border of the second lumbar vertebral bodies should not project beyond their anterior borders unless the pelvis is moderately dilated. A moderate or even large renal pelvis located at the usual level will have its posterior border at the same vertical level as the posterior border of the vertebral bodies. Thus, anterior displacement would be easy to determine by the forward displacement of the posterior border of the renal pelvis. Minor degrees of pelvic enlargement do not normally project beyond the anterior border of the bodies.

The posterior border of the superior calix lies from 2.0 to 3.5 cm posterior to the posterior border of the inferior calix. This indicates that a position of the superior calix approaching that of the inferior calix in the vertical plane may be of importance.

The measurements of the four kidneys located at lower levels indicate the expected anterior position in these few cases.

It is believed that this information may be of value in the diagnosis of retrorenal abscess or tumor.

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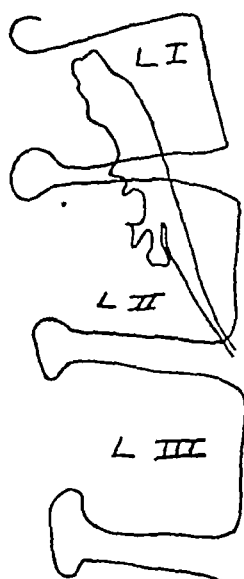


Fig 1 Case I The average position of the kidney in 31 cases

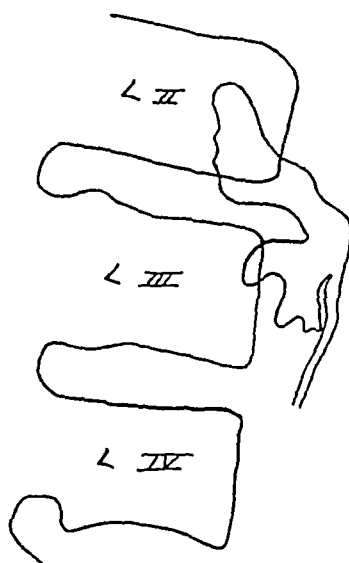


Fig 2 Case II Actinomycosis in the right flank

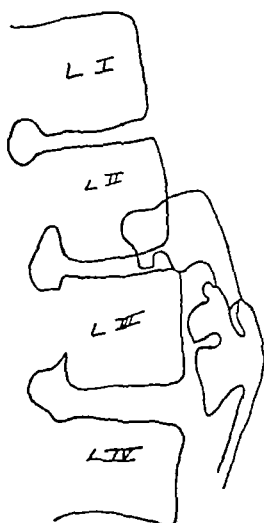


Fig 3 Case III Bifid pelvis with pyelectasis

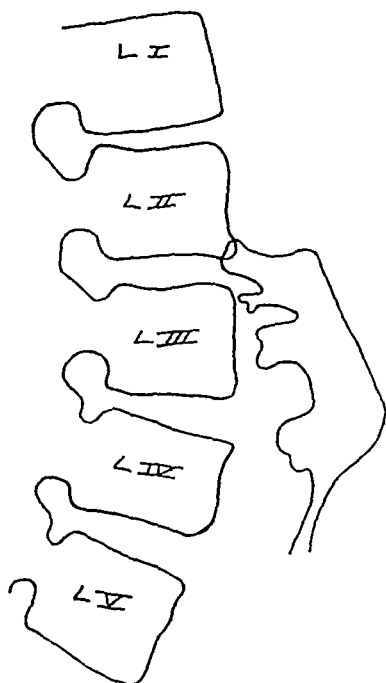


Fig 4 Case IV Prostatitis with pyuria

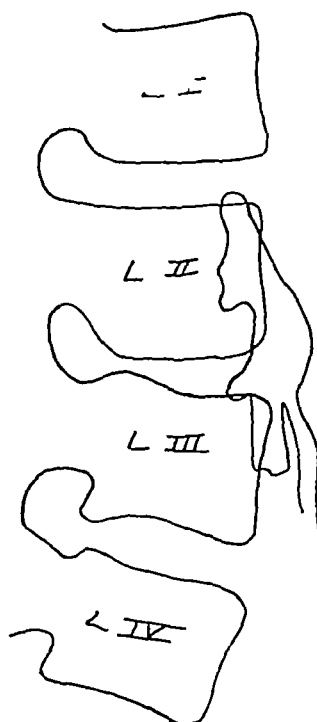


Fig 5 Case V Enuresis without demonstrable urinary disease

the maximum number of "serrations" per millimeter which could be distinguished in the developed image. The shape of the silhouette so obtained, however, is such that the unsharpness characteristic of the emulsion tends to obscure the serrations by "filling in" the valleys between them and thus to obscure the pattern in such a way as to limit its value in determining the true resolving power. Furthermore, as is

produced by photographic procedure, a device is required which will produce lines of any desired width separated by unexposed spaces of the same width. For example, if an image is to be produced, composed of five lines per millimeter, each line must be 0.1 mm wide and the intervening spaces 0.1 mm wide so that the total width of a single line and space will be 0.2 mm. Again, if the line-group image

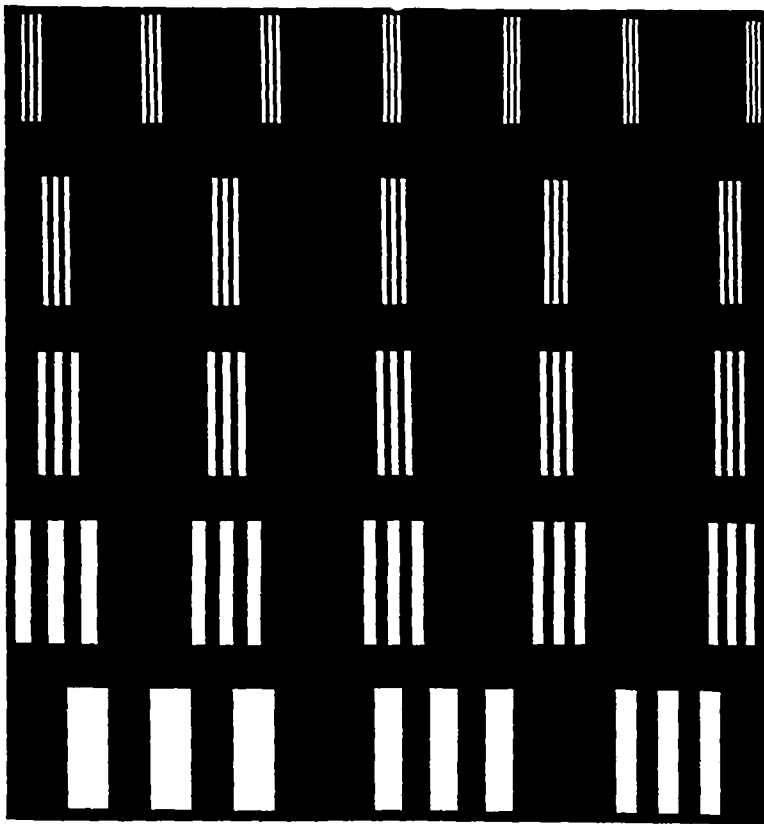


Fig 1 Line drawing test object used in measuring the resolving power of photographic materials

pointed out in more detail later, since the thickness of the wire decreases rapidly toward its edge, the mandrel test object has a high inherent unsharpness characteristic especially for radiation of high penetration. In an effort to avoid these difficulties and at the same time to obtain a measure of resolving power of x-ray materials comparable to that used in photography, the method described below was devised. In order to produce a line-space pattern having the same type as that

is to consist of ten lines per millimeter, the lines must be 0.05 mm wide and the spaces 0.05 mm wide, giving a total width for one line and one space of 0.1 mm. In general, therefore

$$w_1 = w_2 = \frac{1}{2n} \text{ and } w_1 + w_2 = \frac{1}{n}$$

where  $w_1$  = width of a line  
 $w_2$  = width of a space and  
 $n$  = number of lines per millimeter

# Measurement of Resolving Power of Intensifying Screens<sup>1</sup>

WILLARD W VAN ALLEN<sup>2</sup> and RUSSELL H MORGAN, M D \*

ONE OF THE MORE important characteristics which determine the interpretative value of a roentgenogram is the ability of the film or film-screen combination to record detail. A quantitative measure of this characteristic, therefore, is needed in order to evaluate accurately the various types of screens and films available to the radiologist, as well as to assist in determining the optimum conditions of technic. Because of difficulties to be mentioned later, satisfactory methods of measuring this ability to record detail have not previously been developed. In this article such a method is described and the results obtained with a number of commercial screens are tabulated.

In the case of photographic materials, the procedure has been fairly well standardized. It consists of photographing on the material to be tested, either by contact or projection, a test object such as that shown in Figure 1, containing a series of alternate lines and spaces of different width. The number of lines per millimeter which can be distinguished on the processed material, then, is a measure of the ability to record detail and is called *resolving power*. If the test object is photographed, the resulting figure for resolving power will be a measure of the resolving power of the lens-film combination and will not be greater than that of either component alone. The same applies to printing by projection. If the test object is printed by contact, the result will be the resolving power of the emulsion alone. In general, therefore, the resolving power recorded by any emulsion is limited by that factor of the optical-photographic system having the lowest resolving power.

It has been shown (1) that the resolving power obtained by these methods depends

upon a large number of factors other than the photosensitive material itself, namely, (a) the line-space ratio of the test object, (b) test object contrast, (c) level of illumination, (d) development time, (e) wave length of light, (f) composition of the developer, (g) developer concentration, (h) developer temperature, (i) reduction and intensification, (j) dyes. Obviously, therefore, any determination of resolving power must be made under carefully standardized conditions if the results are to be comparable and reproducible. The first of these factors, the line-space ratio, has been generally fixed at 1, that is, the lines and spaces are of equal width. The other factors are easily controlled or are dictated by the technic and therefore determined by the conditions of test. Thus, in x-ray procedures, the wave length of the radiation is determined by kilovoltage, character of structure being radiographed, and type of intensifying screen used, dyes are encountered only as they are incorporated in different types of films.

The difficulties in determining the resolving power of x-ray materials—film alone, film-screen combinations, or lens-screen-film combinations—arise primarily in the preparation of a suitable test object. While it is theoretically possible to prepare a test object of alternate strips of lead and intervening spaces to take the place of the black and white ruled lines used in photography, the practical difficulties encountered in making such an object are enormous. Resolution measurements of x-ray materials have been made (2) with considerable success by use of a test object consisting of a mandrel on which are wound several turns of silver wire of different diameters, the resolving power of the material or system being expressed as

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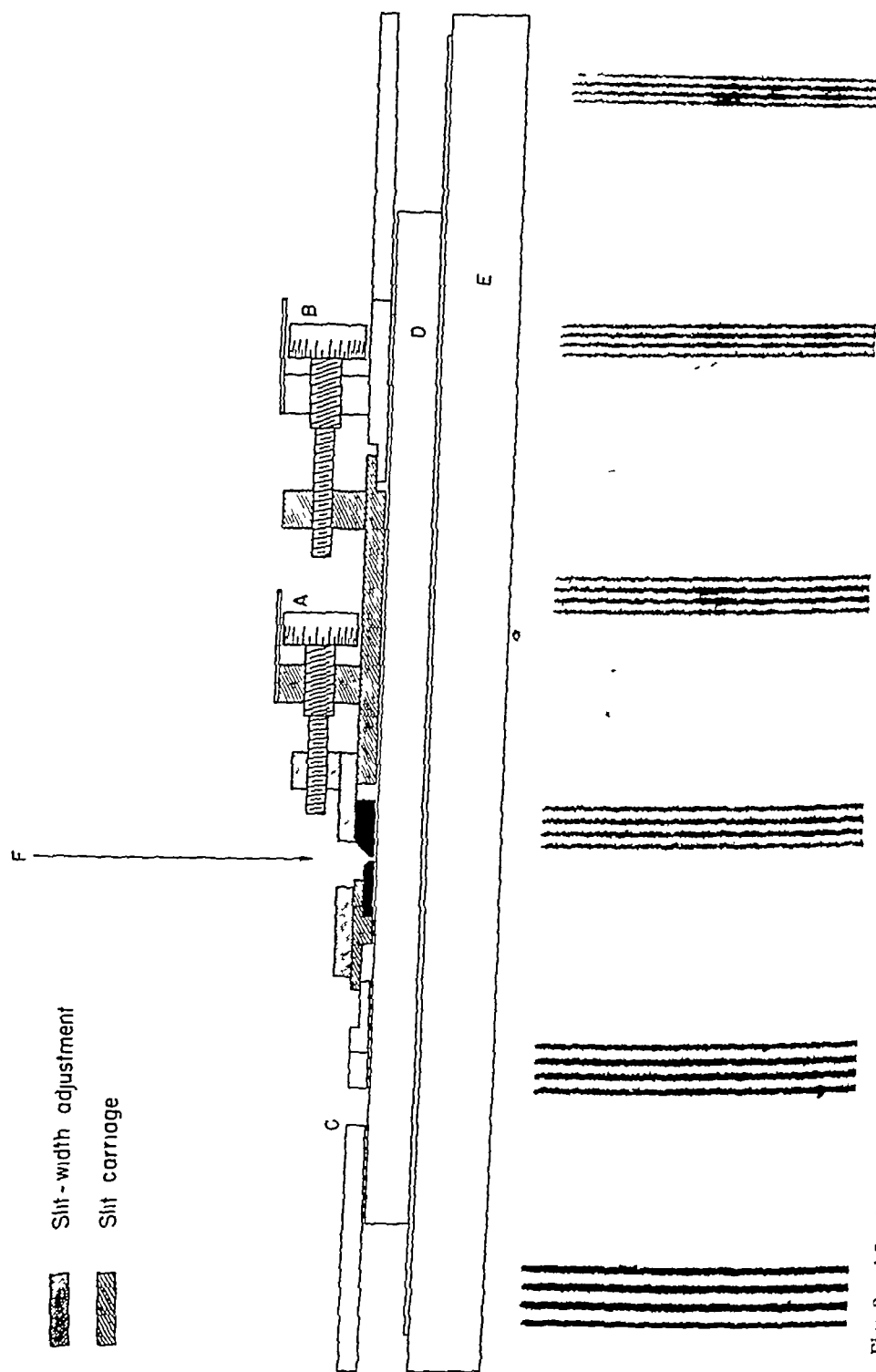
These requirements will be met by a device having a slit of adjustable width formed between two blocks of a radiopaque alloy and a mechanism by which this slit system may be moved laterally between exposures a distance equal to twice the width of the slit. Then, if a film is given an x-ray exposure through such a slit, the slit system is moved laterally twice its width, and another exposure is made, and so on, an image will be obtained on the film consisting of a group of lines separated by unexposed spaces of the same width as the lines. This pattern is obviously the same as that obtained by photographing a ruled test object by conventional photographic methods. To produce an image-group of  $n$  lines per millimeter, therefore, the slit must be adjusted to a width of  $1/2n$  mm and the slit system moved  $1/n$  mm between successive exposures.

The apparatus, shown diagrammatically in Figure 2, consists essentially of a slit system formed by two lead alloy blocks mounted on a carriage which can be moved laterally by means of the differential screw  $B$ . The width of the slit can be adjusted by means of the differential screw  $A$ . The port  $C$  allows an exposure to be made on the film under the same conditions that are used for the line-group images, so that the results may be interpreted in terms of the density produced in a large "spot" by the same exposure factors used in producing the line-group image. The whole mechanism rests on the cassette  $D$ , in which are placed the screen and film under examination.

In use, the slit system is adjusted to a width corresponding to slightly fewer lines per millimeter than the expected resolving power of the film or film-screen combination being tested, then an exposure is made. Next, the slit-system is moved twice the width of the slit and another exposure is made, and so on until a group of four or five lines is produced. The slit system is then adjusted to correspond to a higher resolving power by narrowing the slit, and another series of

exposures is made as above. This procedure is repeated until a series of line-group images has been made, including the expected resolving power of the film or film-screen combination. The film is processed and examined under low magnification, the resolving power being taken as the number of lines per millimeter in that group of exposures in which the lines are just distinguishable. An enlarged view of a typical series of line-groups is shown in Figure 3. It was found that the results were not affected by the size of the focal spot nor by the addition of collimating ports between the tube and the slit. It was necessary, however, to take precautions in aligning the tube and slit to insure that the rays enter the slit in a direction perpendicular to its plane so that the effective width of the slit is not reduced by parallax.

With the use of the apparatus as described above, a series of exposures was made employing a number of commercially available screens and films at 30 kv p with no added filtration, 50 and 60 kv p with 2.0 mm aluminum filtration, 70 kv p with 4.0 mm aluminum, 90 kv p with 0.5 mm copper, and 100 kv p with 1.0 mm copper, corresponding, respectively, to half-value layers of 0.45 mm, 1.76 mm, 2.0 mm, 4.0 mm, 6.8 mm, and 10.0 mm aluminum. No difference in the resolving power of these screens was found under the various conditions of radiation wave length, and, consequently, further tests were confined to radiation at 60 kv p with 2.0 mm of aluminum. Resolving power measurements were made at exposures resulting in "spot" densities ranging from 0.1 to 2.8 above base and fog and under normal processing conditions. Blue-sensitive film was used for blue-fluorescent screens and green-sensitive film for green-fluorescent screens. The resolving powers of these films alone, *i.e.*, without screens, were found to be considerably greater than the resolving power of the screen-film combinations. Therefore, measurements of the screen-film combinations give essentially the resolving power of the screens themselves.



Figs 2 and 3 Diagram of slit mechanism used in measuring the resolving power of x ray films and screens and typical series of line group images obtained from an x-ray screen film combination by the use of this system A Cassette B Test exposure port C Slit carriage D Slit-width adjustment E Typical series of line group images obtained from an x-ray screen film combination by the use of this system F Direction of x-ray beam

These requirements will be met by a device having a slit of adjustable width formed between two blocks of a radiopaque alloy and a mechanism by which this slit system may be moved laterally between exposures a distance equal to twice the width of the slit. Then, if a film is given an x-ray exposure through such a slit, the slit system is moved laterally twice its width, and another exposure is made, and so on, an image will be obtained on the film consisting of a group of lines separated by unexposed spaces of the same width as the lines. This pattern is obviously the same as that obtained by photographing a ruled test object by conventional photographic methods. To produce an image-group of  $n$  lines per millimeter, therefore, the slit must be adjusted to a width of  $1/2n$  mm and the slit system moved  $1/n$  mm between successive exposures.

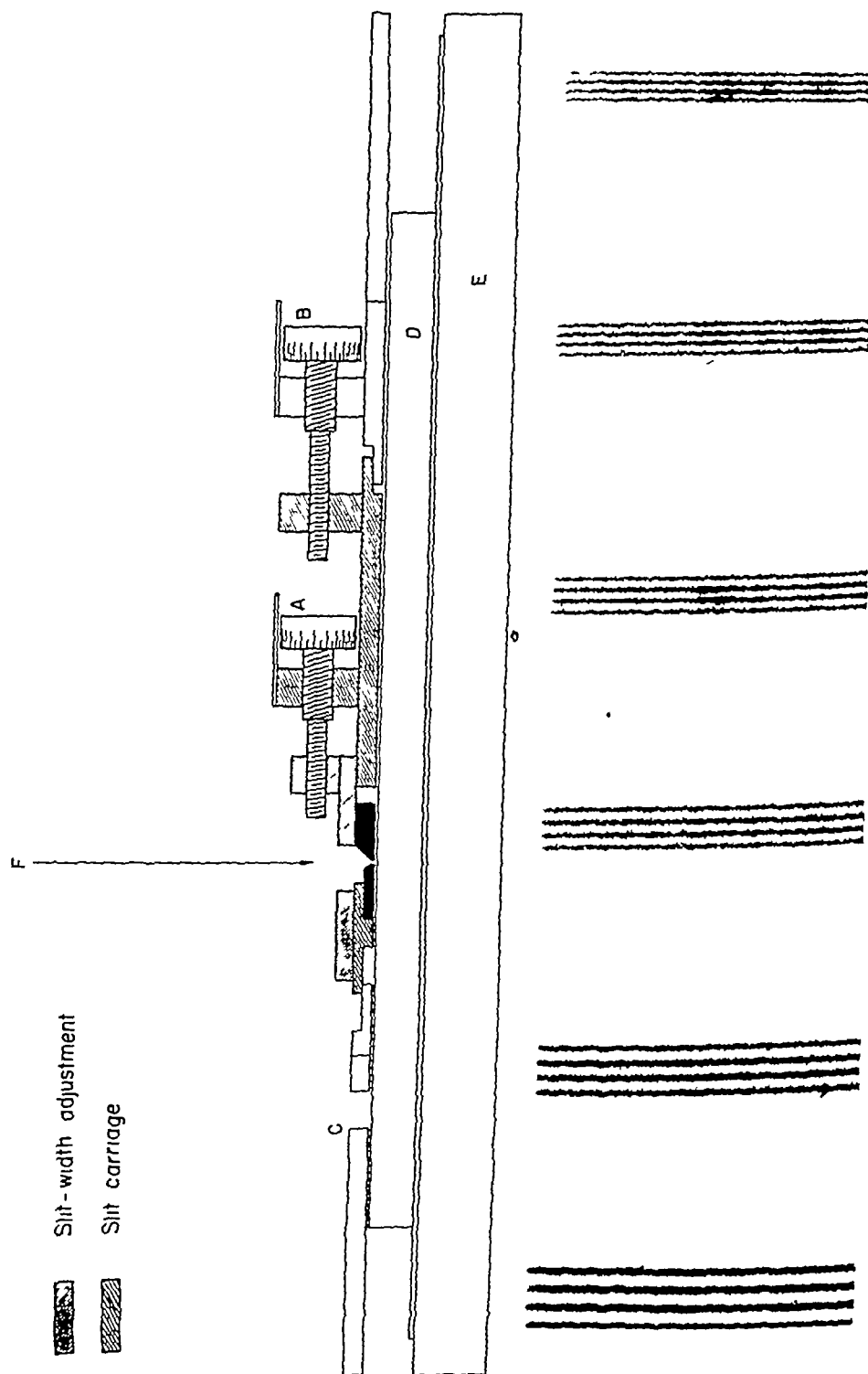
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Figs 2 and 3 Diagram of slit mechanism used in measuring the resolving power of x ray film and screens and typical series of line group images obtained from an x ray screen-film combination by the use of this system. A Slit carriage B Differential screw which adjusts the width of the slit C Test exposure port D Cassette F Direction of x ray beam

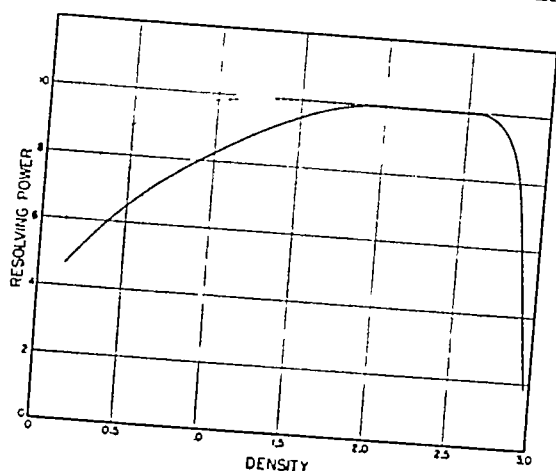


Fig 4 Relationship between resolving power and density for a typical x-ray film-screen combination "Spot" density vs resolving power is shown by the solid line, calculated image density vs resolving power is shown by the broken line

The maximum resolving powers of the screens tested are tabulated in Table I. It is interesting to note the striking similarity in resolving power not only of screens of different manufacturers, but even of screens of the same manufacturer rated by him as "high-definition," "medium-speed," and "high-speed," since in general it would be expected that high-speed screens, with their coarser grain structure, would show an appreciably lower resolving power than the finer-grained "high-definition" screens. It appears that only one "high-definition" screen (C) possesses a significantly greater resolving power than the average screen. From the standpoint of resolving power alone, therefore, there seems to be little to recommend one screen over another except in the one instance. A typical graph of resolving power in relation to "spot" density is shown in the solid line in Figure 4. It is seen that the resolving power rises to a maximum at a spot density of about 1.9, remains constant at this maximum to a spot density of about 2.6, and then falls off rapidly.

As mentioned above, resolving power was found to be independent of the wave length of the x-radiation. Morgan (2), using the wire-wound test object, found that the resolving power dropped off as the wave length of the radiation decreased.

TABLE I RESOLVING POWER OF COMMERCIAL SCREENS ACCORDING TO TYPE AND MANUFACTURER

Type of Screen	Manufacturer		
	A	B	C
High definition	12 $\frac{1}{2}$	10	17 $\frac{1}{2}$
Medium speed	12 $\frac{1}{2}$	10	10
High speed	10	9	
Industrial		6	
Fluorographic, blue-fluorescent	7		
Fluorographic, green-fluorescent	6		

This discrepancy can probably be explained by the fact that the silver used in making Morgan's test object is not entirely radiopaque, absorbing radiation as the wave length decreases, by the fact that the thickness of the wire is not uniform but decreases rapidly toward the circumference. For these reasons the silhouette produced by this type of test object is less sharp than it would be if the object were of uniform thickness and of greater opacity to x-radiation. Thus at the shorter wave lengths, the image will not only show a greater unsharpness, but the effective diameter of the wire will be less, due to penetration of the thinner edges by radiation of shorter wave lengths. The same size wire thus appears smaller and less sharp at the shorter wave lengths, so that the serrations, although distinguishable at exposures of longer wave lengths, become indistinguishable when the radiation is more penetrating. These conditions do not prevail with the mechanism described above, since the edges of the slit are thick enough to be radiopaque at all wave lengths used. In this connection it might perhaps be argued that spurious results could be obtained from radiation scattered by the edges of the lead slit. That this is not the case is shown by the fact that no differences in resolving power were obtained after careful collimation of the x-ray beam before it entered the slit. Furthermore, since the width of the slit is very small compared with the thickness of the edges, the effect of the slit is to collimate its own beam, any radiation scattered at the entrance is absorbed by the opposite wall.

The results discussed above and shown

graphically by the solid line in Figure 4 give the resolving power of the screen-film combinations as observed in an image consisting of a group of lines on an unexposed background, plotted against the density produced in a relatively large spot by the same exposure. If the density of each line were equal to that of the spot and the spaces between the lines were clear, this curve would represent the relationship between resolving power and image contrast. Unfortunately, this ideal condition does not prevail, as will be apparent from the following considerations of the characteristics of a line-group image.

The film blackening is due almost entirely to light received from the screen, that due to direct x-radiation being negligible. The amount of light produced by the screen is the result of direct excitation by incident x-rays through the slit, plus excitation due to x-rays scattered by the screen itself, plus excitation due to the luminescence of adjacent crystals of the screen. The intensity of the light produced by the first of these effects, the direct absorption of the primary radiation, is independent of the width of the slit, but the intensity produced by scattered radiation in the screen and self-excitation is not. As the width of the slit decreases, the amount of radiation scattered by the screen decreases, as does the excitation of the screen by its own luminescence. These effects combine to produce a much lower total brilliance for narrow slits than for wide slits, even though the incident radiation remains constant. Hence, as the width of the lines decreases, the density of each line also decreases, so that the density of a line approaches that of the large spot only for lines of considerably greater width than those in an image at the maximum resolving power. In other words, the *exposure-density*, measured in the spot, is greater than the actual image density, except for very wide lines. It is evident, therefore, that the *contrast* between the line-group image and the background is not the same as the contrast between the control spot and the background.

Furthermore, as the lines are brought closer and closer together, the unexposed "clear spaces" between them are more and more encroached upon by the diffuse density due to the unsharpness characteristic of the line images so that, even before the limit of resolution is reached, these unexposed spaces are no longer clear. This merging of the regions of unsharpness, as the space between the lines decreases, builds up the density in the spaces until, at the limit of resolution, the density in the spaces is so nearly equal to that of the lines themselves that their individuality can no longer be distinguished, since the contrast has dropped to zero. This image, however, was produced by alternate equally exposed and unexposed areas, so that the density produced in the line-group image at the limit of resolution is the same as the density which would be produced in a spot of equal size by one-half the exposure. If the resolving power is plotted against the density produced by one-half the exposure, as calculated from the *D-log E* curve of the film, there results the curve shown by the broken line in Figure 4, a curve more closely approximating a graph of photographic resolving power *versus* contrast.

In the foregoing discussion, only images produced by a test object of infinite contrast have been considered. In practical roentgenography, detail is almost invariably recorded as differences in density produced through selective absorption of radiation as it passes through tissues or other material under examination and hence almost never approaches the ideal provided by a test object of infinite contrast. The practical radiologist, therefore, is more interested in the resolving power of a screen-film combination at different *exposure-contrasts* and different density levels than in the maximum resolving power under conditions of infinite contrast. Obviously the *exposure-contrast* is determined by the quality of the radiation and the nature of the subject, and the density of the image is determined by the exposure. It is important to determine, therefore, the optimum conditions of wave length

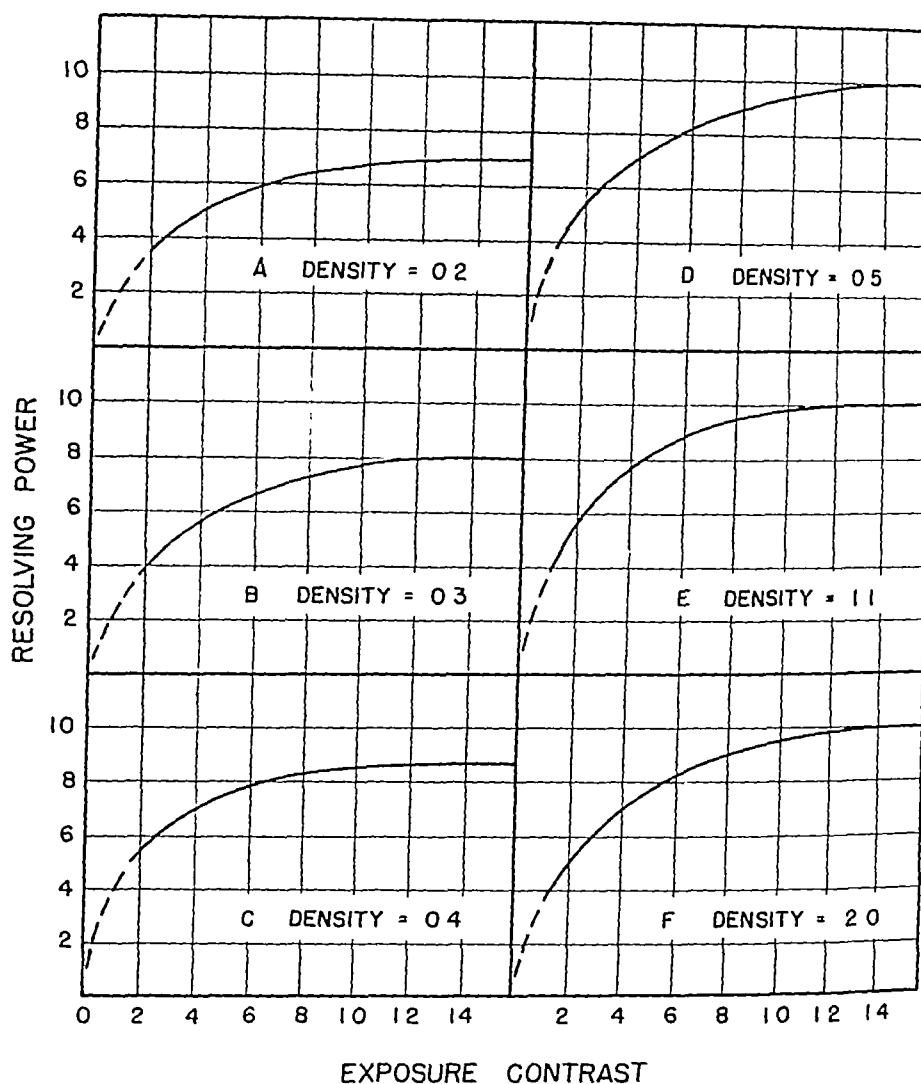


Fig 5 Relationship between resolving power and exposure contrast at different total densities for a typical film-screen combination having a maximum resolving power of 10 lines per millimeter

and exposure (i.e., exposure contrast and density) which will give the greatest possible resolution for a given type of material

In order to determine the resolving power at different densities and exposure contrasts, a series of tests was made on screens having a maximum resolving power of ten lines per millimeter, in which the film was first given a uniform pre-exposure, after which it was exposed through the slit as described above. In each series, the exposures were calculated to give the same total image density, so that gamma could be considered essentially constant

for the series, while the exposure contrast was varied. That is, if an exposure  $E_0$  is required to produce a density of, say, 1.0, and  $E_1$  is the pre-exposure, the second exposure through the slit must be

$$E_2 = 2(E_0 - E_1)$$

since, at the limit of resolution, the density produced in a line-group image is equal to that produced by one-half the exposure, as discussed above. The total density in the example given, then, is 1.0 and the exposure contrast can be varied and will equal

$$C = \log(E_1 + E_2) - \log E_1$$

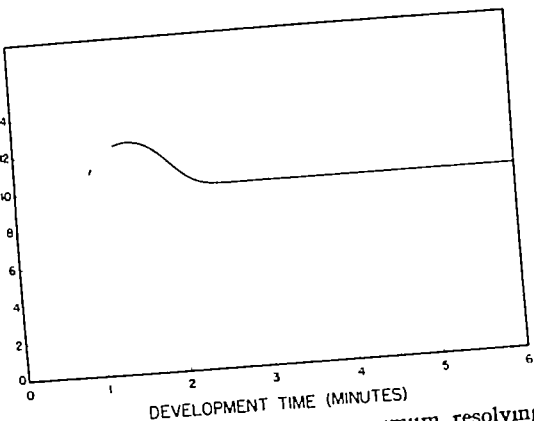


Fig 6 Relationship between maximum resolving power and development time for a typical film-screen combination

The results, for six different total density values, are shown in Figure 5. It is seen that for low densities, that is, up to and including 0.4, the maximum resolving power increases with density, but does not reach the maximum of ten lines per millimeter of which the screen is capable. At densities of from 0.5 to 2.0, the maximum resolving power is attained at minimum exposure contrasts varying from 1.1 at a density of 1.1 (*E* in Fig 5) to 1.4 at densities of 1.0 and 2.0 (*D* and *F*, Fig 5). Furthermore, if the exposure contrast in a given problem is necessarily low because of the nature of the material under examination, the greatest resolution appears to be given at an image density in the neighborhood of 1.0, since the curve of resolving power at that density (*E*, Fig 5) rises most rapidly, indicating the greatest resolving power at a given exposure contrast of any in the series. The radiologist interested in maximum detail will, therefore, choose kilovoltage and exposure so that exposure contrast and density will approximate, as closely as possible, the values indicated by these curves.

The equation

$$R = R_{\max} (1 - e^{-aD})$$

has been suggested (1) as representing the relationship between resolving power and test object contrast, where  $R$  is the resolving power for any test object contrast  $D$ ,  $R_{\max}$  is the maximum resolving power,  $D$  is the test object contrast, and  $a$  is a con-

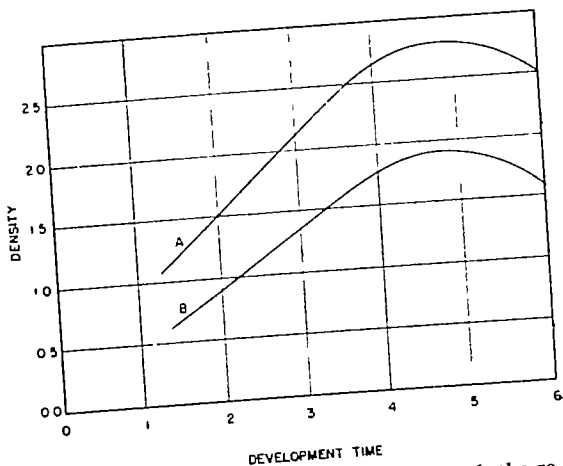


Fig 7 Range of "spot" densities in which the resolving power is a maximum at different development times. Curve A shows the maximum and curve B the minimum density at which the resolving power is maximum.

stant. Although in these x-ray studies it is not possible to vary the contrast of the test object itself as in photography, the exposure contrast, which is identically equal to test object contrast, was varied as described above. Attempts to fit this equation, with  $D$  equal to exposure contrast, to the results obtained for resolving power as a function of exposure contrast result in curves which vary systematically from experimentally determined values for any value of  $a$ . This would seem to indicate that the equation does not adequately describe the relationship between resolving power and exposure contrast. Further studies are necessary, therefore, to discover a satisfactory equation connecting these quantities.

The effect of development time on maximum resolving power was investigated with results shown in Figures 6 and 7. Figure 6 shows that, for extreme overexposure and very short development, the resolving power is somewhat greater than the maximum obtained under normal processing conditions, but that otherwise the maximum resolving power is not affected by over- or underdevelopment.

Figure 7 shows the range of "spot" densities in which the maximum resolving power occurs as development time increases. Curve A is the maximum density and curve B the minimum density at

which the resolving power is at the maximum. It is interesting to note that as the development time increases, the density at which maximum resolving power occurs first increases and then falls off under conditions of overdevelopment, reaching its peak at approximately normal development time. Thus the resolving power under conditions of overexposure and underdevelopment is a maximum at densities considerably lower than those required for maximum resolving power under normal conditions of development. On the other hand, the maximum resolving power occurs throughout the greatest range of densities under conditions of normal exposure and development.

#### SUMMARY

Apparatus and method for measuring the resolving power of x-ray films and film-screen combinations have been described.

The resolving power of several commercial screens has been measured and the results are tabulated.

The relationship between resolving power and density has been investigated.

The relationship between resolving power and exposure contrast at different density levels has been studied, and on the basis of these results, technique for maximum detail is discussed.

The effect of development time on resolving power has been investigated.

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U S Public Health Service  
Bethesda, Md

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# Roentgen Findings in Erythema Nodosum<sup>1</sup>

CAPT WILLIAM L. BONNET, M C A U S

THE ETIOLOGY of erythema nodosum is not specific, since it is believed that it may be caused by almost any infectious disease. Apparent outstanding sources are rheumatic fever, tuberculosis, syphilis, and infections caused by the gonococcus and meningococcus.

Histologic examination of the lesions of erythema nodosum shows that there are dilatation of the capillaries and extravasation of serum, leukocytes, and erythrocytes into the surrounding tissues. The bruised appearance assumed on healing is due to the disintegration of red blood cells.

The eruption consists of poorly defined, nodular lesions varying in diameter from a few millimeters to 5 or 6 cm. The lesions are prone to appear on the shin but may occur on any of the extremities or on the buttocks. The overlying skin is smooth, shiny, and generally of a rose red color. Ulceration seldom takes place, the nodules appear in crops, last from a few days to several weeks, and slowly disappear (1). The eruption is usually preceded by mild constitutional symptoms, as fever, malaise, and pain in the muscles and joints, and is sometimes accompanied by definite polyarthritides.

In treatment of these cases, emphasis should be placed on determination of the underlying etiologic factors and their correction or removal. Tests for sensitivity to tuberculin, streptococcus protein, and coccidioidomycin should be performed. A number of the streptococcus-sensitive patients have proved to have rheumatic fever (2). Analgesics, especially salicylates, are useful when the eruption is accompanied by pain. Soothing lotions may be applied.

A white male, age 22, height 6 feet 7 3/8 inches, weight 240 pounds, gave a childhood history of measles, mumps, pertussis, and scarlet fever. He had

a right inguinal hernia repaired at the age of two. His mother and father, three sisters, and six brothers were living and well. A maternal aunt had died of pulmonary tuberculosis.

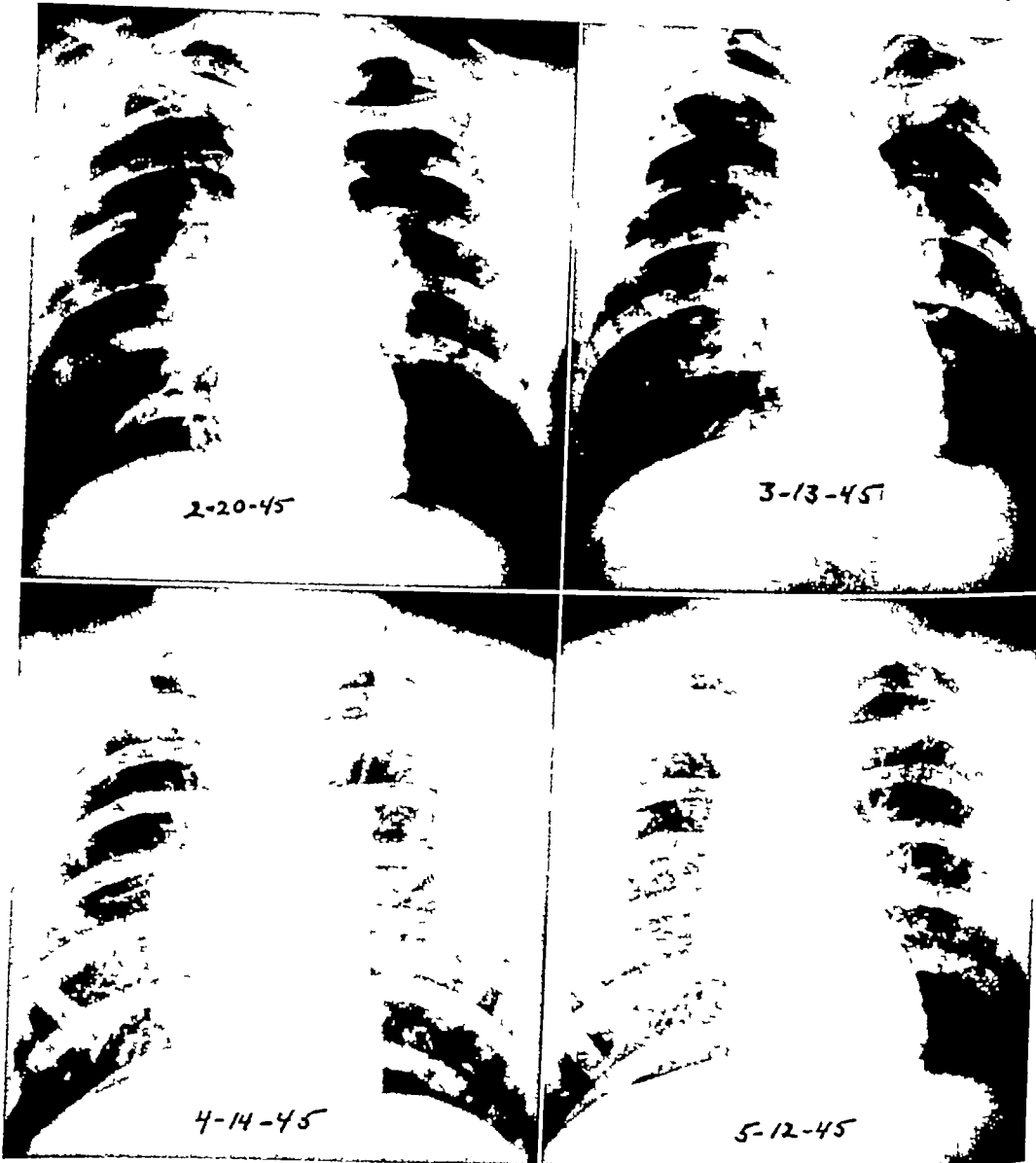
At the age of eighteen, the patient had begun working in a fire-brick mill, an occupation which entailed exposure to minimal amounts of chrome and magnesium dust. He wore a respirator for only two weeks, while working on a detail sifting silica dust. His main assignment for twenty months was on the maintenance crew, repairing pipes crossing above the kilns which were covered with silica dust, to which he was thus occasionally exposed. During this occupation he suffered one attack of heat exhaustion of a week's duration, but no other illness. At the age of twenty he was inducted into the Army and his assignment as aircraft mechanic was fulfilled with no illnesses until December 1944.

For approximately two months the patient experienced occasional pain in the arch of the right foot. In February 1945, the pains became more severe, and headaches and coryza developed. Later, pains occurred in the left ankle and knee and the interphalangeal joints of the left middle and ring fingers. At this time bilateral, symmetrical, tender red nodules, about 2 inches in diameter, appeared over both pretibial areas. The throat became inflamed, the cervical nodes were swollen and tender, and there were tenderness, redness, and increased temperature of the left ankle and knee.

The patient was hospitalized and salicylate therapy was given, producing some relief of the joint pain. During February and March the temperature ranged from 100° to 103°, but remained normal after April 1945.

A chest film taken Feb. 20, 1945, showed massive hilar nodes and accentuation of the bronchovascular markings. The possibilities of a lymphoblastoma and of a primary tuberculous adenitis were considered. By the end of February, the redness, swelling, and tenderness of the pretibial areas began to subside, but the roentgen signs in the chest persisted. The rash had completely disappeared by the end of March, but at this time further enlargement of the hilar areas was demonstrable roentgenologically, with a small amount of radiating, mottled infiltration extending out from each hilus. The possibility of sarcoid was now suggested, but x-ray examination of the hands and feet showed no evidence of bone involvement and there were no typical sarcoid skin lesions. A chest film taken April 14, 1945, showed diffuse hilar and linear involvement of the periphery of the lung fields with a slight regression in the size of the hilar and mediastinal nodes. Considerable parenchymal involvement was still pres-

<sup>1</sup> Accepted for publication in October 1945.



Figs 1-4 Successive films showing pulmonary involvement in erythema nodosum

ent on May 12, 1945. Further examination on July 9 showed almost complete regression of the mediastinal and hilar node involvement with minimal residual parenchymal involvement.

Various laboratory examinations were performed, beginning in February. Twelve sputum examinations were negative for tubercle bacilli. A heterophile antibody test and blood Kahn and skin tuberculin tests were also negative. Coccidioidomycosis was eliminated by several negative skin tests. The sedimentation rate was elevated to 43 mm on Feb 21, 1945, but remained normal after March. The highest leukocyte count was 13,000 on Feb 21, with

74 per cent polymorphonuclears and 26 per cent lymphocytes. The red count varied from 4,170,000 to 4,760,000. Urinalyses were repeatedly negative. Electrocardiograms, in February, showed a relative increase in the P-R interval with the rate remaining constant and inverted T 3's. Electrocardiograms in July showed the P-R interval to be normal and the T 3's to be upright.

As intimated above, the differential diagnosis in this case was rather involved. Silecrosis, coccidioidomycosis, rheumatic fever, tuberculosis, lymphoblastoma, sar-





Figs 5 and 6 Later films of case shown in Figs 1-4, showing regression of the lesions in the lungs

coidosis, infectious mononucleosis, and erythema nodosum all entered into consideration. There has been observed an association of erythema nodosum with primary tuberculosis, acute coccidioidomycosis, and hemolytic streptococcal infection, presumably when cutaneous allergy to the products of these organisms is at a high level (2). Cases of erythema nodosum have been reported in connection with iodism, with sulfathiazole, and with other drug intoxications. Holt and McIntosh have seen the condition in association with chronic ulcerative colitis in patients failing to react to tuberculin or to streptococcal protein (2).

Sante (3) mentions that sarcoid or erythema nodosum may produce a roentgen appearance similar to tularemia pneumonia. The involvement may spread to the periphery of the lung and show miliary infiltrations resembling miliary tuberculosis, which, however, finally clear. Sante further states that in the nodular stage of silicosis there is a similarity to sarcoid, erythema nodosum, various forms of mycotic infection, and leukemia.

In view of the polyarthritis, electrocardiographic changes, and elevated sedimentation rate, all of which had disappeared at the time of this report, though there

was still residual fatigability, a diagnosis of rheumatic fever is most logical in the case here recorded. The erythematous spots on the legs, which developed in February and subsequently turned purple, and the enlarged hilar nodes and parenchymal involvement probably represent erythema nodosum with both skin and pulmonary changes on an etiologic background of rheumatic fever. The absence of bone or skin changes characteristic of sarcoidosis, the negative tuberculin and coccidioidomycin skin tests, the negative heterophile antigen tests, and the clearing of the pulmonary fields and reduction in size of the hilar nodes all favor a diagnosis of erythema nodosum.

The accompanying series of x-ray films illustrates the pulmonary changes throughout the observation period.

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# Versatile Erect Bucky for Private Office Radiography

With Description of Horizontal Bucky Table Mounted on Floor Track<sup>1</sup>

GILBERT W. HEUBLEIN, M.D., D.Sc. (Med.) in Radiology

Hartford, Conn.

**A**N ERECT Bucky, herewith described, has been found flexible and efficient for private office radiographic work. It is particularly helpful in radiography of shoulders and fractured ribs and in skull, sinus, mastoid, and mandible examinations. The effectiveness of the Bucky is increased by providing the radiographic room with a table which moves on casters over a floor track. Held in proper alignment by the track, this table is exactly centered with reference to the erect Bucky and the plate changer at opposite ends of the radiographic room. The position of the Bucky in relation to the radiographic table and plate changer is shown schematically in Figure 1.

Firmly fixed to the floor and wall, the vertical Bucky stand is mounted on two steel upright tubes which house a counterweight. The Bucky is of the 14 × 17-in. high-speed type and is mounted on two extension arms projecting from the center casting. This allows for 180° rotation, so that the bakelite face can be used as a table top for extremity examinations (Fig. 6). The rotation mechanism is controlled by a counterbalancing coil spring. The vertical moving mechanism is mounted on large ball bearings and accurately counterbalanced.

The erect unit is fitted with a special sinus tunnel for non-Bucky work, allowing for two exposures on an 8 × 10-in. cassette. This is shown in Figure 7. Our routine sinus examination consists of the following projections, all of which are made in the upright position after the manner suggested by Pendergrass (1): (a) Caldwell and Granger projection, (b) routine erect Waters position with mouth closed and Pirie projection made in an exaggerated Waters position with open mouth, to pro-

file the sphenoidal air cells, (c) stereoscopic postero-anterior oblique views of the ethmoidal capsules, (d) a single lateral film of the frontal sinuses, as well as a special lateral view of the antra and sphenoidal sinuses. In certain instances it is helpful to procure an anteroposterior film in the erect posture with the head tilted to right or left in order to demonstrate a shifting fluid level. We consider the erect posture extremely helpful in demonstrating mucocoeles and other types of mucosal thickening.

A cassette holder is available for long-distance cervical spine radiography. The holder is fitted over the bakelite face of the unit, thus accommodating any size of cassette up to and including a 14 × 17. This can be regularly used for all non-Bucky technics with or without a Lysholm grid and with any degree of angulation required.

The Bucky table is supported by heavy cast-iron legs, which provide both rigidity and stability. The legs are furnished with large hard rubber, ball-bearing casters. The casters on the tube-stand side of the table are grooved in order to follow the floor track, which controls the longitudinal movement of the table. The table is fitted with both a locking mechanism and interconnecting tube-stand lock.

The equipment described above is useful in the following examinations:

(a) *Conventional study of the cranium*  
Erect positioning is often essential in obtaining an accurate submentovertex projection, or Bowen-Hirtz view of the base of the skull, since extension of the cervical spine is more readily accomplished in the upright position. Also in the anteroposterior projection of the foramen magnum, with the central ray directed from the hairline to the base of the skull (Towne projection), flexion of the cervical spine is

<sup>1</sup> Accepted for publication in October 1945

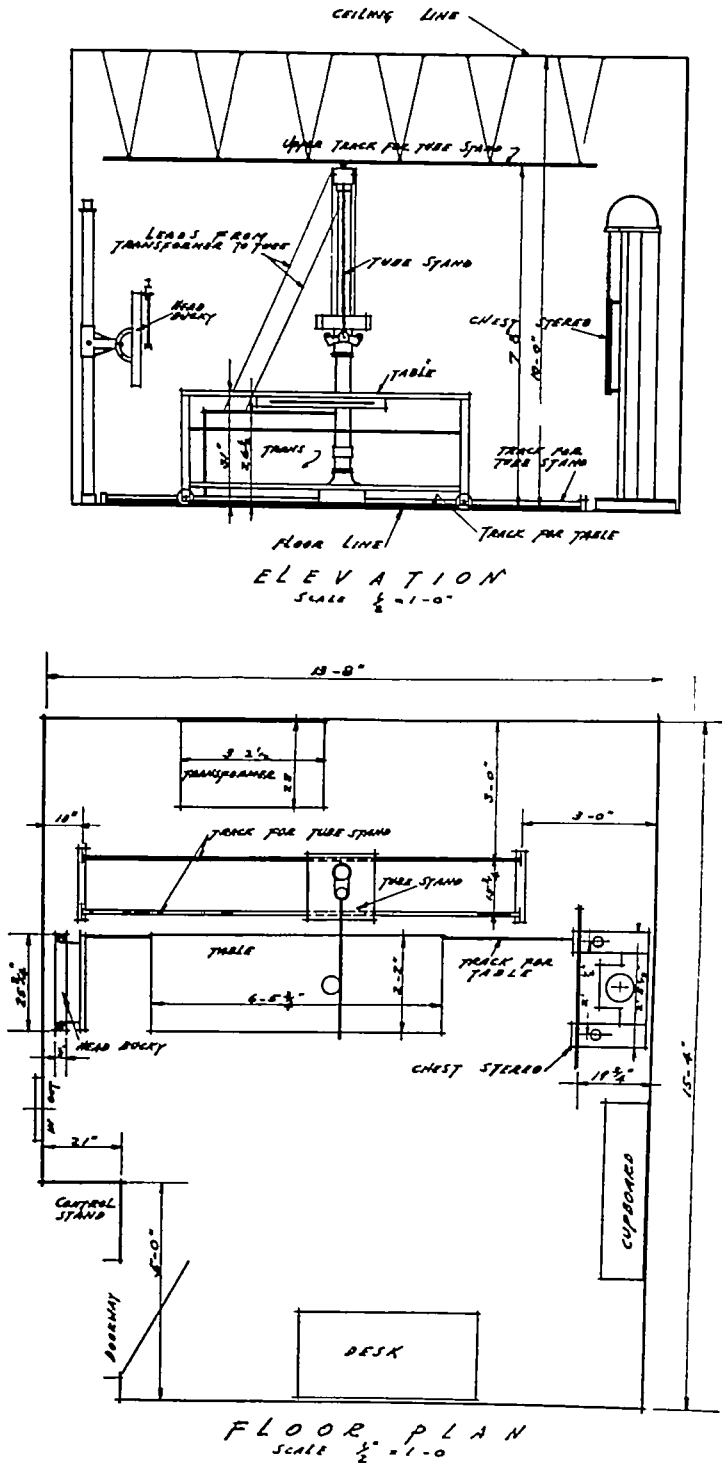


Fig 1 Floor plan of x-ray room showing relationship of horizontal table to erect Bucky on the left and the plate changer on the right. Note track for tube stand and single track for table. The horizontal Bucky table can be pushed to either end of the room to allow for adequate working space at either erect Bucky or plate changer (Original floor plan designed by Mr. William Hogan, Franklin X-ray Company, Philadelphia. Drawing by R. W. Reynolds.)

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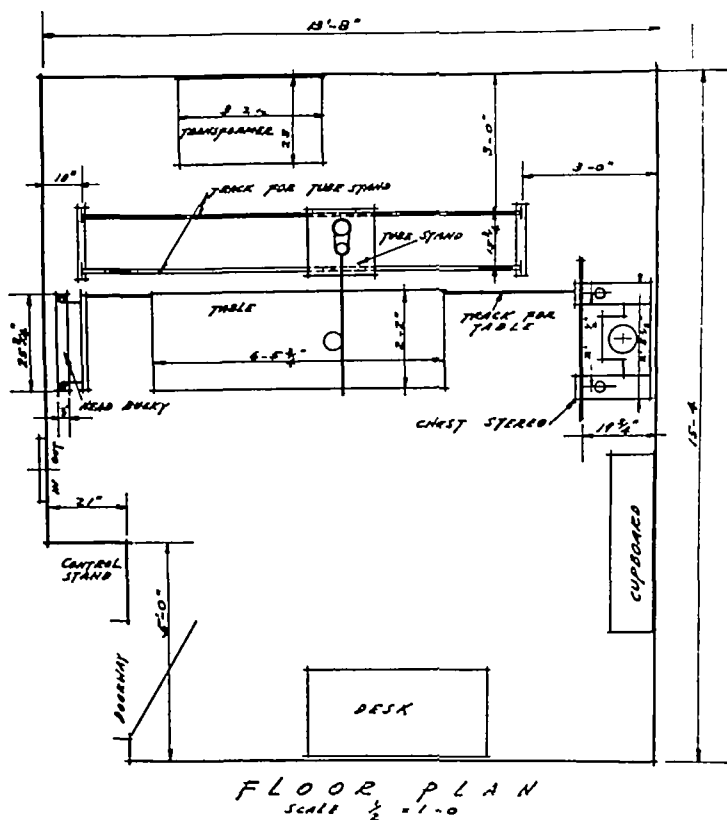
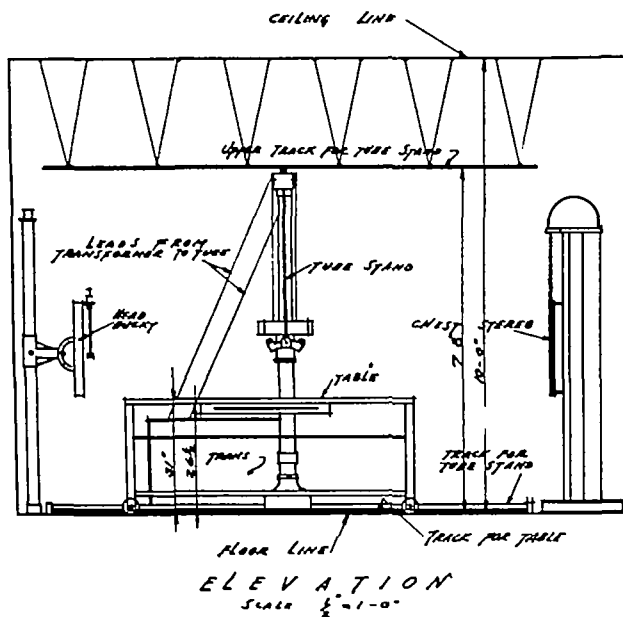


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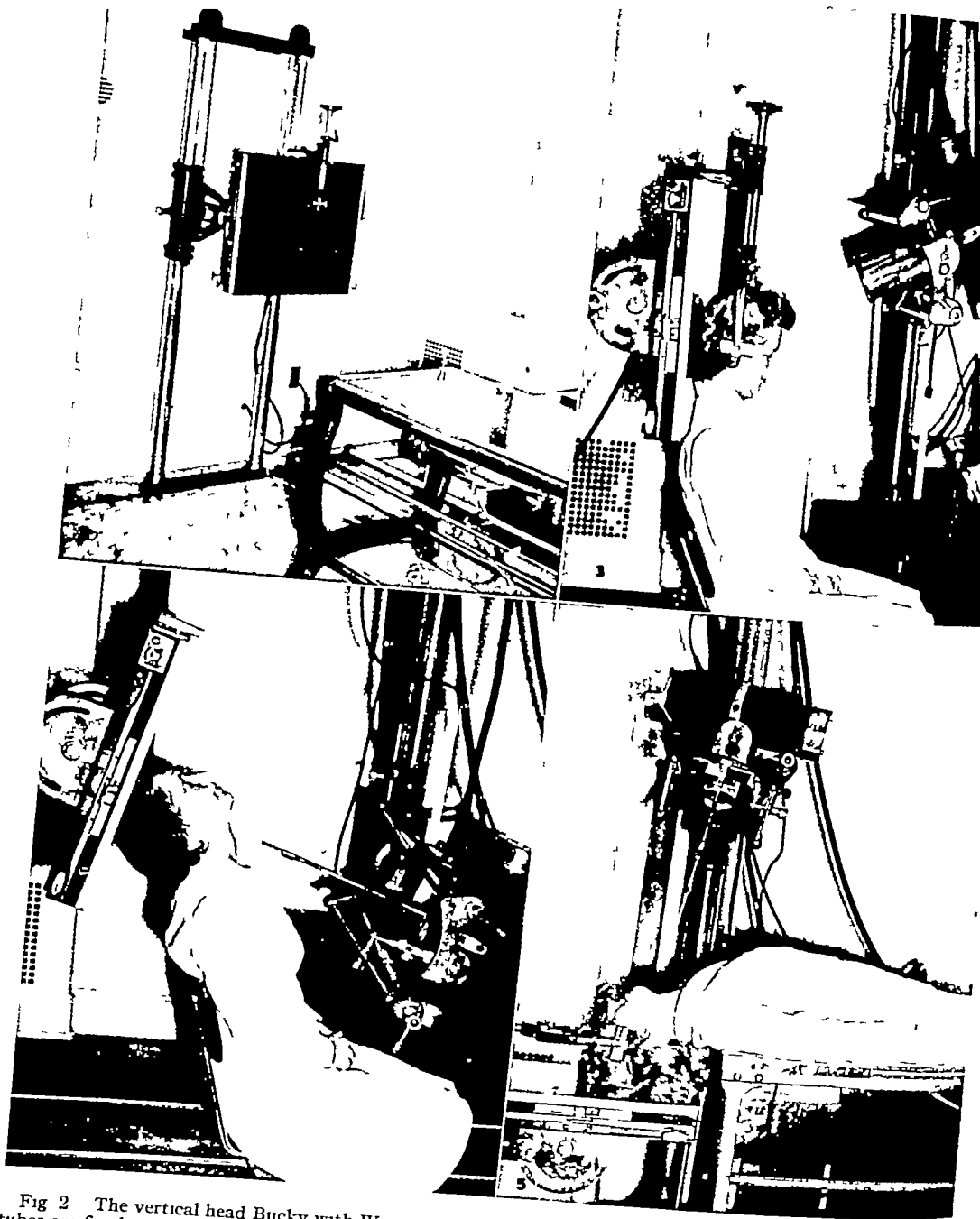


Fig 2 The vertical head Bucky with Westinghouse head clamp in position. The upright steel chrome plated tubes are firmly attached to the floor and wall, insuring stability and consequent elimination of unsharpness due to motion. The grooved caster on the floor track is well shown at *a* and the extension arm at *b*.

Fig 3 Illustration showing the ease with which the Bucky can be used in making the conventional Towne projection of the skull. Exposures in this projection are often made with difficulty in the horizontal and dorsal decubitus positions, particularly in short-necked thick-chested patients. In this instance a 25° tilt is being employed.

Fig 4 A most satisfactory method of obtaining the Bowen-Hirtz or submentovertex projection with the vertical Bucky stand. The central beam is directed at right angles to Reed's base line and centering midway between the mental point and the prominence of the thyroid cartilage at the thyroid notch. Positioning is facilitated by the use of the erect position.

Fig 5 The table and Bucky headstand can be used effectively in combination in order to demonstrate the base of the cranium in the supine position. A slight modification of this position can be utilized in order to profile the zygomatic arches (Henderson projection).

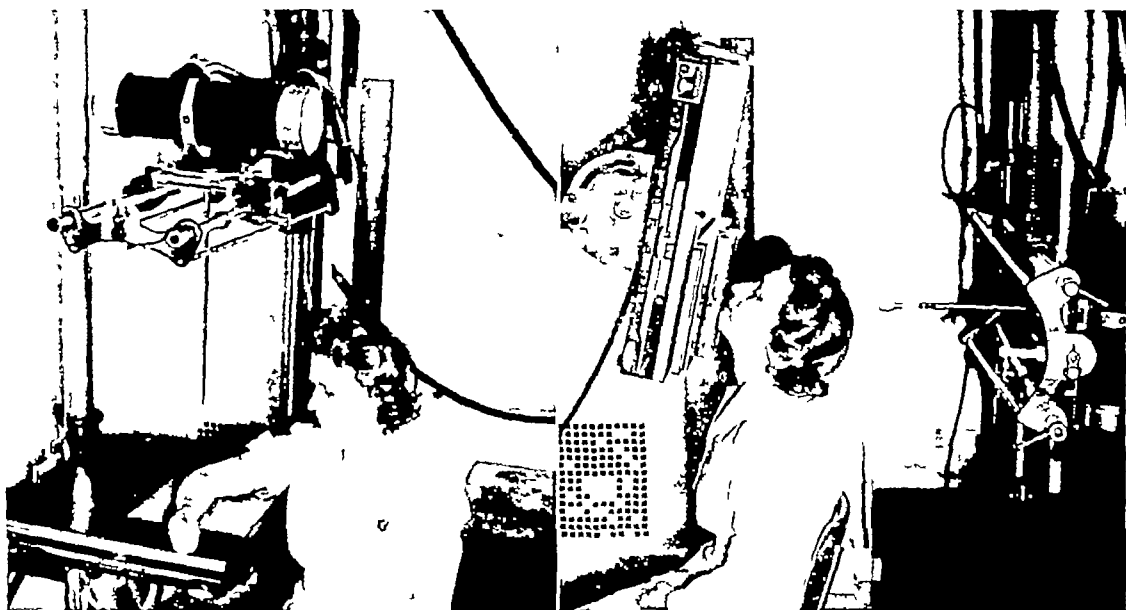


Fig 6 (left) The erect Bucky may be used as a table top for radiography of extremities, as the elbow, hand or wrist. The Bucky table is easily adjusted to the various levels necessitated by the size of the patient.

Fig 7 (right) Waters projection on sinus tunnel with  $8 \times 10$ -inch film in place. This device allows for two exposures on each film. A nasal aperture is provided for the Caldwell projection. Exposures are made through a cone with  $2\frac{1}{4}$ -inch aperture.

more easily accomplished. In lateral examinations of the cranium, more exact evaluation of lesions of the hypophyseal fossa is obtained by employing a slight tilt of the erect Bucky, angulating the Bucky face  $10^\circ$  from the perpendicular. This is a most useful device for obtaining true lateral films of the skull in short-necked individuals.

(b) *The temporomandibular articulations*  
The technic suggested by Pendergrass (2) is used, employing a  $23^\circ$  angle from the horizontal plane in the lateral projection and a  $35^\circ$  angle with the chin depressed in the anteroposterior direction. Examination of the mandible and mastoid air cells, including the Mayer projection, as described by Danelius (3), and studies of the zygomatic arch are rendered easy.

(c) *Routine and special sinus views (as indicated above) and particularly the optic foramina*. The erect posture is found especially useful in demonstrating the optic canals. The chin is extended but slightly, in a minimal Waters projection, and the head is rotated  $45^\circ$  to profile the desired canal.

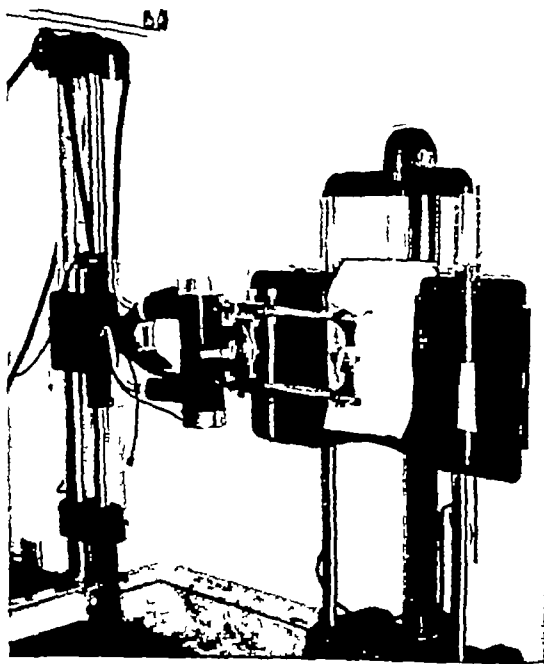


Fig 8 Illustration showing relation of tube stand to plate changer with horizontal table moved to the opposite end of the room. With young children, however, the table often serves as a convenient platform, whereby projections can be made in the erect position. Hence, it is often advisable to move the table directly to the base of the plate changer to act as a support for the patient.

(d) *Various types of injuries*, particularly rib and shoulder lesions, which may require erect positioning in order to avoid pain, lateral transthoracic examination of the proximal humerus

(e) *Gastro-intestinal and gallbladder examinations*, and particularly as a means of obtaining clear and brilliant lateral decubitus films of the abdomen. A recent diagnosis of chronic intussusception of the ileum was made possible by obtaining films in the above projection. In selected cases the study of sinus tracts and fistulae is facilitated

(f) *Examination of arm, forearm, hand, wrist, and elbow*, with the Bucky face used as a table top (Fig 6)

This equipment has been in use approximately six years and has required no special attention. No mechanical trouble of even a minor nature has developed. The accompanying illustrations show the ease and flexibility with which the device

can be used. It is difficult to describe its performance in words. It is gratifying that a number of radiologists have inspected the equipment and have commented on it with favor. The technicians working with it declare it has rendered exceptional service in all types of radiography, but particularly in the studies described above.

NOTE Both the erect Bucky and the horizontal movable table were designed, constructed, and installed for the author by Mr. William Hogan, President of Franklin X-ray Company, Philadelphia.

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# Unsuspected Pneumoperitoneum<sup>1</sup>

CAPT HAROLD A COLE, M C, A U S, and LT COL CLARENCE J BERNE, M C, A U S

IN CASES OF suspected pneumoperitoneum due to rupture of a hollow viscus, whether spontaneous or traumatic, upright films should be taken to demonstrate air beneath the diaphragm or, where the patient is too ill to sit upright, an antero-posterior projection may be made in a lateral decubitus position, in which instance the gas will collect beneath the lateral abdominal wall (Fig 3). The percentage of patients reported as showing roentgen evidence of free gas in the peritoneal cavity following rupture of a hollow viscus varies, but the accepted average is 75-80 per cent.

In unsuspected cases where the routine scout supine abdominal view alone has been taken, Rigler has noted a valuable roentgen sign demonstrating the presence of free gas in the peritoneal cavity. This consists in the ability to visualize the inner and outer walls of the bowel. The lower density of gas within the intestine and the free extraluminal gas surrounding it will sharply delineate the outer as well as the inner wall, furnishing a sign which, as stated by Rigler, is pathognomonic of pneumoperitoneum. This sign was observed in our case when we were still unaware of Rigler's findings. The case is presented because of the comparative roentgen studies and surgical management.

## CASE REPORT

A 21-year-old American infantryman was wounded on June 15, 1944, by fragments from an exploding Japanese hand grenade thrown into his foxhole. The patient had apparently been in a crouched position with his head down and was struck by the fragments, at close range, from behind. Operation the following day, in the forward area, consisted in debridement of wounds over the buttocks, thighs, and legs, with application of casts. The patient was then evacuated to our hospital, on June 17, about fifty-four hours after being wounded.

Upon admission, the patient was dehydrated and in a state of exhaustion. His chief complaints were

of discomfort due to the wounds about the buttocks, scrotum, and lower extremities. The findings were as follows:

*Temperature* 98.8° F

*Head and Neck* Negative

*Chest* Few shallow penetrating wounds posteriorly

*Lungs* Clear to percussion and auscultation

*Heart* No murmurs or arrhythmias

*Abdomen* First reported as negative

*Back* Numerous small penetrating wounds

*Scrotum* Large, dirty, draining wound on posterior surface, 2 cm. in diameter

*Buttocks* Covered with multiple wounds, ranging from 2 to 10 cm in diameter, and of varying depth, with a dirty greenish discharge

*Rectal Examination* No abnormal findings,

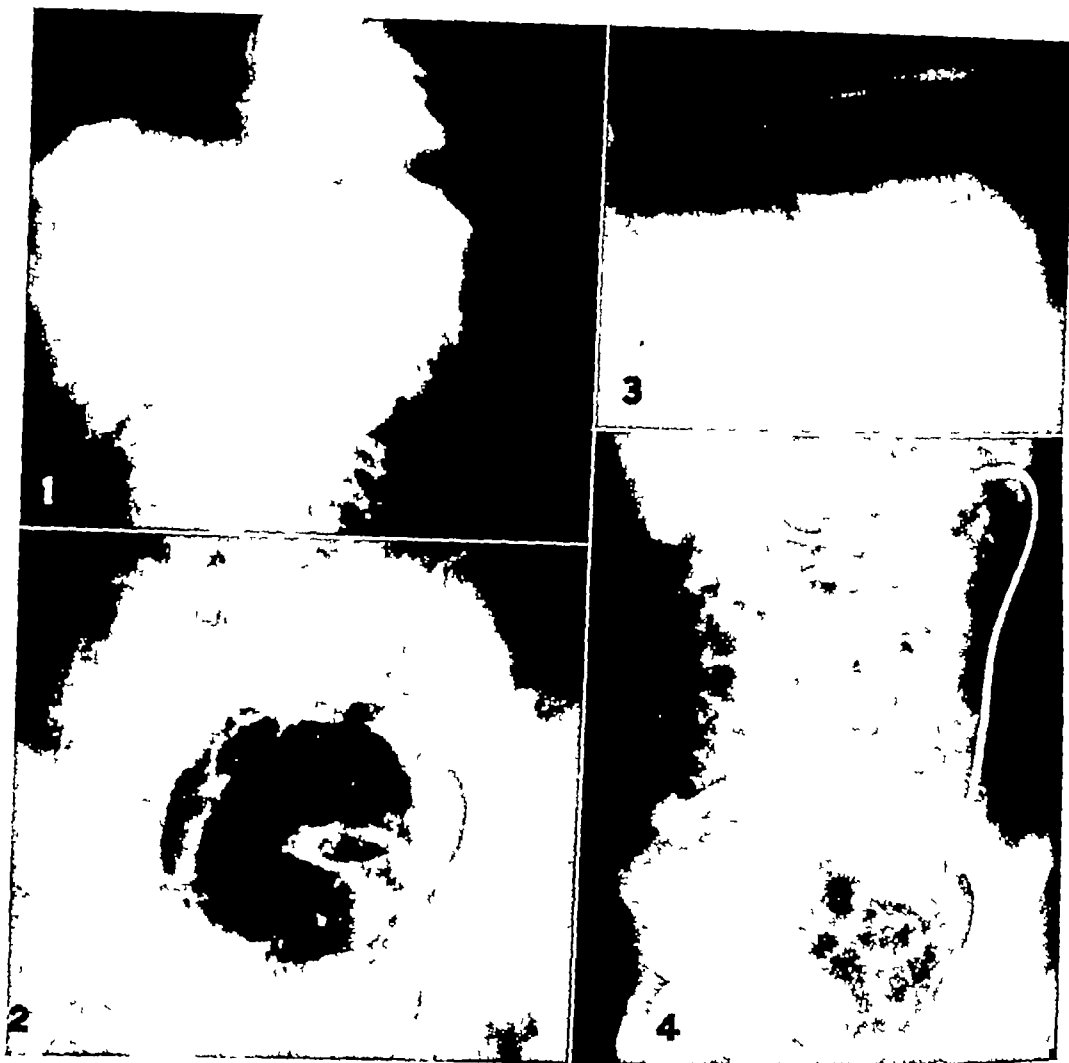
*Extremities* Few small penetrating wounds of both arms and forearms, with two draining wounds about 1 cm in diameter on right arm and forearm. Both thighs posteriorly were covered with multiple penetrating wounds of various sizes. There were six large, dirty, draining wounds on the lateral surface of the right thigh. The right leg showed a 2-cm draining wound on the lateral surface of its lower third and numerous small penetrating wounds draining pus. The right foot was swollen and tender. There was a large dirty wound, 16 × 8 cm, exposing muscles and tendons, on the lateral surface, also, a dirty draining wound, 2 cm in diameter, laterally, opposite the head of the fifth metatarsal. Another dirty 2-cm wound was present on the plantar surface.

Immediately after admission and removal of casts the patient received a general fluoroscopic survey.

*Roentgen Findings* The soft tissues of the feet and legs, particularly the right, were filled with small grenade fragments, typical of those from a Japanese grenade. There was a comminuted compound fracture of the right os calcis and of the proximal portion of the fifth metatarsal with the fragments displaced into the adjacent soft-tissue defect. Scattered metallic fragments were identified throughout both thighs and buttocks, a few about the back and chest, and also throughout the upper extremities. Many fragments about the pelvis seemed to lie within the true pelvic cavity, but none was identified elsewhere within the general abdominal cavity.

Because of the discomfort from the lesions over the buttocks, scrotum, and lower extremities posteriorly, the patient was fluoroscoped in a prone position. With him lying thus, a huge amount of free air was seen beneath the diaphragm, surrounding and clearly defining the liver and spleen, and displacing them caudally. Because the surgeons

<sup>1</sup> Accepted for publication in September 1945



Figs 1 and 2 Conventional supine views showing silhouetting effect of free air on the pelvic colon. In Fig 1 small irregular radiolucent areas are also seen about the ascending colon.

Fig 3 Lateral decubitus view showing effect of free air on the ascending colon.

Fig 4 Film made one week later. The silhouetting effect on the pelvic colon and small collections of air about the ascending colon have disappeared.

were not present, an abdominal film was taken—the conventional scout supine view (Figs 1 and 2). The paucity of findings was so distinct in contrast to the marked pneumoperitoneum demonstrated on prone fluoroscopy that a decubitus view was also taken in order to have convincing evidence for the surgeons (Fig 3). It was presumed that the grenade fragments had perforated intestinal coils within the pelvis.

The white blood count was 15,000 with 85 per cent polymorphonuclears and 15 per cent lymphocytes. The red blood count was 2,410,000. Urinalysis was negative.

*Course.* The diagnosis of pneumoperitoneum following perforation of intestinal coils, probably colonic, having been established, it was decided to

treat the patient conservatively. He was placed on an Ochsner regime, including intubation by a Miller Abbott tube and systemic sulfonamide therapy. Transfusions of 500 c.c. of blood were given the next two days, followed by daily administration of 200 c.c. of plasma and parenteral fluids.

The day after admission the abdomen was found to be tense, but without definite rigidity, and exquisitely tender throughout, with marked rebound tenderness. Peristalsis was absent. No masses were palpable. There was questionable dullness in the flanks.

Peristalsis was observed within forty-eight hours, but the entire abdomen remained tender, with rigidity in both lower quadrants. Three days after admission, however, the patient showed considerable

improvement. The abdomen was softer and less tender. Peristalsis was present, though faint. The nurse was moderately febrile, the temperature reaching 102.4° F. Part of the febrile reaction was considered to be due to the wounds in the extremities. On June 22, under pentothal anesthesia, the wounds on the right leg and foot were revised, with removal of necrotic tissue. The wound on the lateral surface of the foot was extended and considerable pus drained. Hydrogen peroxide and vaseline gauze dressings were applied, and the right lower extremity was placed in a posterior molded splint. The wounds on the buttocks and scrotum were also cleansed and dressed.

On the sixth day after admission, the abdomen was soft, flat, and non-tender, and peristalsis was present. The Miller-Abbott tube was removed but was reinserted because of crampy abdominal pains and vomiting. At a later date a small amount of sodium was administered through the tube. This allowed an unimpeded passage, with essentially normal motility. There was progressive improvement, and on the tenth day the abdomen was normal to physical examination. The tube was clamped off, and fluids by mouth were well tolerated. There was now only a mild febrile reaction. Improvement continued, and on July 11, 1944, about three weeks after admission, the patient was evacuated. He was febrile, eating well, and free of abdominal symptoms.

#### DISCUSSION

A case of unsuspected pneumoperitoneum following perforation of intestinal coils by grenade fragments is presented. Cure followed conservative therapy.

The initial demonstration of pneumoperitoneum was by *prone* fluoroscopy, in which instance abdominal compression had forced the gas beneath the diaphragm, producing an effect as striking as that noted in Figure 3.

The instructive feature of this case is the comparison of the silhouetting effect of the free air on the pelvic colon in the conven-

tional supine view (Fig. 2) with that on the ascending colon in the lateral decubitus view (Fig. 3). Also, if one studies the region of the ascending colon on the supine view (Fig. 1), small irregular radiolucent areas are noted lateral to the colon beneath the lateral abdominal wall, not conforming to any intestinal pattern and representing small collections of free gas delineating the outer wall of the colon. The inner wall is indistinct because of fecal material within the lumen. A film taken a week later (Fig. 4) shows disappearance of the silhouetting effect on the pelvic colon as well as of the small collections of air about the ascending portion.

#### CONCLUSIONS

Because the supine view is used routinely in making scout films of the abdomen, proper interpretation of the above radiological findings would permit the detection of such an unsuspected pneumoperitoneum. Further, in suggestive instances of silhouetting, a suspicion is provided and constitutes a basis for the taking of the classical views. Comparison of Figures 1 and 2 with Figure 3 reveals the relative magnitude of roentgen evidence of pneumoperitoneum in the supine as compared with the decubitus view.

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# Absorption of Pantopaque Following Myelography<sup>1</sup>

CAPT WILLIAM G PEACHER, M C, A U S, and MAJ ROBERT C L. ROBERTSON, M C, A U S.

WE HAVE PREVIOUSLY described our experiences with pantopaque, including the spinal fluid reaction and the comparative value of the medium in contrast myelography (2). Preliminary notes were given as to its absorbability in 65 of 300 cases in which spinograms were made. Observations were carried out at varying intervals following the procedure, with the following results

No of Cases	Absorption	Time
17	0 2 c c	1 mo
10	0 4 c c	2 mo
16	0 5 c c	3 mo
22	0 03-1 0 c c	4-12 mo

Roentgenograms of the skull were taken in 48 cases and 14 of these (29 per cent) showed small amounts of pantopaque in the basal cisterns

Little material has appeared dealing with the absorption of pantopaque. Mayfield (1) mentioned that when a few droplets were retained, absorption took place in two to four months. In 2 additional cases in which 3 to 4 c c of oil remained, none was present on examination six months later. Ramsey, French, and Strain (3) gave the average estimated absorption rate as 1 c c in one year.

Wyatt and Spurling (4) obtained follow-up roentgenograms of 6 patients from nine to fifteen months after injection. They found absorption to be more rapid during the first few months in cases with greater oil retention. The higher rate of absorption sometimes observed was believed to be due to the nature of the contrast medium and the emulsifying action of body movement. No pantopaque was observed in films of the skull, cervical or dorsal spine. Our findings agree essentially with those of Wyatt and Spurling except for x-ray studies of the skull.

Two hundred and forty-seven follow-up studies have been made at intervals of one to twenty months after injection of panto-

paque in a series of 640 myelograms. In the beginning, studies were made of the entire subarachnoid system, including the cervical, dorsal, and lumbosacral spine and skull. Since the cervical and dorsal regions rarely showed evidence of retention, subsequent investigations were limited to the skull and lumbosacral spine. Although many cases show fixation after two to three months, this is not always true, particularly when larger amounts of the medium are retained. This has been demonstrated both fluoroscopically and in successive x-ray studies. No deleterious symptoms or signs have been noted in addition to the findings already recorded (2).

Estimates as to absorption were made by first measuring the amount of oil removed at the time of myelography. Successive anteroposterior and lateral films of the lumbosacral spine and skull were then compared to determine the size of the residual pantopaque shadow, which was stated in terms of cubic centimeters. There was a tendency toward a relative decrease in the density, as well as the size, of the residual medium over varying periods of time. All examinations were made by one observer (W G P), to minimize the possibility of error. The following table shows the results, representing an average of the cases studied.

No Cases	Absorption	Time
88	0 38 c c	1 mo
37	0 52 c c	2 mo
49	0 54 c c	3 mo
41	0 61 c c	4 mo
16	0 33 c c	5 mo
16	0 36 c c	6 mo +

For obvious reasons incident to military service, long-term follow-up investigations have not been possible except in isolated instances, as listed in the following table. Three cubic centimeters of pantopaque were injected in all cases with the exception of an occasional cervical spinogram, for which 6 c c were used.

<sup>1</sup> Accepted for publication in September 1945

Case	Retention	Absorption	Time
1	2 0 cc	1 2 cc	20 mo
2	0 2 cc	0 05 cc	12 mo
3	0 1 cc	0 1 cc	13 mo
4	0 5 cc	0 4 cc	12 mo

Eleven cases showed complete absorption in amounts up to 0.2 cc over a period of twelve days to five months. Wyatt and Spurling (4) mention one case in which the contrast medium had entirely disappeared (0.5 cc) in eleven months. Further, in our series, 32 cases were noted with 1 to 2.6 cc absorption in periods of one to five months. In these patients, the greater part of the injected oil had been retained.

Extra-arachnoid injection in no way hinders absorption. Moreover, this process appears most rapid during the first three to four months after injection.

Films of the skull were available in 228 cases. Fifty-four (23.6 per cent) showed small amounts of pantopaque in the basal cisterns, most frequently in the cisterna chiasmatis, cisterna fossae lateralis cerebri, cisterna ambiens, and cisterna cerebello-medullaris. The oil was observed in the lateral and third ventricles in only 5 (2.2 per cent) instances. No signs or symptoms were present other than the single meningeal reaction in a pilot following aerobatics, previously recorded (2). Intracranial pantopaque is more likely to be found in those cases in which all the contrast medium is retained. This is not invariable, however, as one patient was seen with 0.1 cc remaining in the lumbar subarachnoid space after injection. Four days later, films of the skull showed the drug to be in

the cisterna chiasmatis. Successive films have revealed absorption in the cerebral as well as the spinal subarachnoid system. This process is usually slow, however, as only small amounts are present. Occasionally, also, when some pantopaque remains in the spinal canal, repeat x-rays show more within the cranium than was noted on the initial examination.

#### SUMMARY

Notes have been presented on 247 cases in which follow-up roentgen studies were made to determine absorbability of pantopaque following myelography, over varying periods of time. Films of the skull were obtained for 228 patients, 54 of these (23.6 per cent) showed small amounts of the contrast medium in the basal cisterns. Only one benign meningeal reaction occurred following intracranial progression.

Valley Forge General Hospital  
Phoenixville, Penna

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# EDITORIAL

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## "Superior Pulmonary Sulcus Tumors"

In 1924, Pancoast (4) described a syndrome the outstanding features of which were an apical lung tumor, demonstrable roentgenographically, referred nerve phenomena in the upper extremity on the involved side, and cervical sympathetic paralysis suggesting a spinal cord tumor, cervical rib, or vertebral neoplasm. Four cases were included in Pancoast's original report and a pleural origin was assigned to the tumors, though he believed that a similar chain of symptoms might accompany other new growths. According to Moersch, Hinshaw, and Wilson (3) this same group of findings had been described in 1838 by Hare, in a contribution in the *London Medical Gazette*, but little attention had been paid to that early report.

In 1932, Pancoast (5) again discussed the subject, before the American Medical Association, adding four cases to his original series. He now discarded a pleural origin for these tumors and suggested that they might arise from an embryonal epithelial rest. He believed that they could not be regarded as primary lung cancers and suggested the name "superior pulmonary sulcus tumor" to designate what he regarded as a distinct pathologic entity. Symptoms included pain around the shoulder, extending down the inner side of the arm, loss of power and wasting of the muscles of the hand, and Horner's syndrome. The roentgenogram disclosed a comparatively small circumscribed shadow at the pulmonary apex, together with destruction of portions of one or more ribs and the adjacent lateral processes or bodies of one or more vertebrae.

Pancoast considered Horner's syndrome an essential feature in the diagnosis of the new tumor and did not admit to the group

apical conditions manifesting only part of the symptom complex. On the other hand, he felt that the condition might be overlooked because of incomplete roentgenographic studies, especially in cases in which pain in the shoulder was the dominant complaint.

More than two decades have passed since Pancoast's earlier report, and nearly a decade and a half since his suggestion that superior pulmonary sulcus tumors constitute a separate pathological entity. In the intervening years many observers have recorded their findings in similar cases, with a consequent clarification of the subject. Jacob (2) in 1934 reported two cases. In one of these, postmortem examination established a diagnosis of primary carcinoma of the pulmonary apex arising from the mucosa of the bronchioles in that area. In the other, no pathologic studies were made but the clinical course was similar.

In 1936, Steiner and Francis (6) recorded three cases, with postmortem confirmation in two and biopsy examination in the third. They believed that their tumors originated in the lung. Clinically they were said to represent a generally unrecognized type of cancer, but the microscopic findings corresponded to types of growth commonly observed in primary pulmonary neoplasms.

Pancoast had considered failure to metastasize a characteristic feature of the tumor, but the experience of later observers is at variance with his opinion. In a case reported by Frost and Wolpaw (1), which proved histologically to be a sympathoblastoma of the superior mediastinum, there was secondary involvement of the upper lobe of the right lung, the esophagus, adjacent vertebral bodies, and ribs. The primary lesion in this case was believed to

arise from the inferior cervical sympathetic ganglion. Steiner and Francis also found metastases in two of their three patients, in one to distant osseous structures and in one to the regional lymph nodes and kidney.

Moersch, Hinshaw, and Wilson in 1940 reviewed the cases seen at the Mayo Clinic in a ten-year period. They encountered thirteen examples in which all the essential features were present and four additional cases in which Horner's syndrome was absent. From these observations they were led to believe that Horner's syndrome may not be present until late in the course of the disease, that it may be a manifestation of the degree of spread of the apical tumor, and not related to a specific neoplastic type. In nine of their cases distant metastases were demonstrable.

The prognosis in apical lung tumors has been almost uniformly bad. All of Pancoast's original patients received radiotherapy, but experienced little or no benefit. In his second report he stated that these tumors resisted all efforts at irradiation, while surgical removal was obviously impossible and was usually rapidly followed by a fatal termination. In one of the cases reported by Jacox, temporary relief from pain, lasting several months, followed administration of deep x-ray therapy. The pain recurred, however, and chordotomy was required for its control. Two of the cases reported by Steiner and Francis received deep x-ray therapy with little relief

of symptoms and no regression of the tumors. Moersch, Hinshaw, and Wilson reported that the great majority of their patients were dead within six months of initial examination.

Great credit is due Pancoast for the recognition of these tumors and the elaboration of the symptom-complex which accompanies them. It is unfortunate that in no instance did he have the benefit of postmortem examination. Autopsies in many of the cases reported later, by other authorities, disclosed primary tumors of the lung and indicated that metastasis was of frequent occurrence. It seems apparent that any tumor in the pulmonary apex which involves the cervical sympathetic nerves may produce this clinical syndrome.

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## NEBRASKA

*Nebraska Radiological Society*—Secretary-Treasurer, Donald H. Breit, M.D., University of Nebraska Hospital, Omaha 5. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln

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not possible or practical in most surveys, but useful for investigation purposes only—S F T]

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A review of the history, rationale, technic, indications, contraindications, sequelae, and complications of pneumoperitoneum therapy in pulmonary tuberculosis is given. The author reports his observations on the roentgen aspects of this method in 61 cases and 6 representative examples are described with illustrative roentgenograms. The effects of pneumoperitoneum which can be observed roentgenologically are: (1) elevation of the diaphragm, which may reach 10 cm or more, combined with a corresponding limitation of diaphragmatic mobility, (2) diminution of lung volume (which may amount to 15 to 35 per cent reduction in chest capacity) combined with compression of cavities, 'crowding' of the bronchovascular markings, and corresponding changes in the appearance of tuberculous lesions as well as of the heart and mediastinum, (3) separation of the subphrenic viscera, especially the stomach, liver, and spleen, from the diaphragm, (4) disappearance of intra-abdominal adhesions. Of complications, ascites is the most frequent roentgenologic finding.

L W PAUL M D

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3 Irreversibility of damage in a certain number of cases. For example, the ciliated membrane may be damaged and not completely restored. Subsequent attacks hit the same weakened area and are more prolonged. Normally non-pathogenic secondary bacteria may carry on the process. This irreversibility explains prolongation, recurrences, and chronicity

4 Continuity: (a) Continuity of Type. Each cold or "flu" may relight the same damaged area. (b) Continuity in Time. Continuous discharges occur after the "cold" has damaged the tissues. (c) Continuity of Structure. The infection may spread between portions of the tract, e.g., sinusitis leading to a bronchitis. (d) Familial Continuity. If the patient has asthma or hay-fever look for a familial history of allergy

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STANLEY H NACHT M D

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The etiology is unknown. Tuberculosis has been excluded. The parasitic theory is plausible, since numerous cases have been reported, mainly in children, in which a blood eosinophilia and transient pulmonary infiltrations were accompanied by intestinal parasites. The allergic theory must also receive consideration, since allergic symptoms have on some occasions led to the discovery of the condition. The seasonal incidence and epidemic form suggest an infectious agent, perhaps an atypical virus. Such an infection would account for the pulmonary infiltration, and its absorption might elicit an eosinophilia.

Some authors regard the lung lesions as due to emboli, infarcts, localized bronchial asthma, or atelectasis. They have also been attributed to a localizing allergic edema, and the name allergic pulmonary edema has been proposed for the disease. Von Meyenburg (*Virchows Arch f path Anat* 309 258, 1942) maintained that the transient infiltrations represent an eosinophilic pneumonia, his findings are based on material from four accidental deaths.

# ROENTGEN DIAGNOSIS

## THE HEAD AND NECK

**Contrast Roentgenography of the Pneumatic Cells of the Temporal Bone** Max Unger *Am J Roentgenol* 54, 384-388, October 1945

With conventional roentgenography, the extent and character of pneumatization of the mastoid process can be determined only partially. In order to obtain more preoperative information, the author has devised a method for the introduction of an aqueous solution of a radiopaque salt into the pneumatic cells. It can be used only where there is a perforated tympanic membrane, a mastoid fistula, or both. It requires a careful washing out of the cells by saline solution with the aid of a pneumatic otoscope and gravity, since the presence of pus, swollen mucous membrane, and polyps will interfere with the results. The entire procedure takes about thirty to forty minutes, but the author believes the information obtained from the subsequent roentgenograms makes the effort worth while.

L. W. PAUL, M.D.

**Endolumbar Pneumoencephalography, Simplified (A Note on Its Advantages)** Joseph H. Globus and John L. Simon *J Nerv & Ment Dis* 102, 412-415, October 1945

In the simplified method of endolumbar pneumoencephalography described in this paper, the air is introduced with the patient lying in his bed, the head of which is raised on shock blocks. The authors have found that this simplified procedure is more comfortable for the patient, easier for the examiner, and equally if not more satisfactory from the point of view of results. Two illustrative pneumoencephalograms are included.

SYDNEY F. THOMAS, M.D.

**Measurement of Relative Exophthalmos by Roentgenography** Benjamin Friedman *U S Nav M Bull* 45, 482-487, September 1945

The author describes a method for measuring relative exophthalmos with x-rays. He uses special contact lenses equipped with a central lead dot. These lenses are placed over the eyes while the patient is lying supine on the x-ray table. A pair of obstetrical calipers supported by blocks is used to maintain the head in the correct position so that the mid-sagittal plane is exactly perpendicular to the center line of the table. As a further aid in positioning, a pair of small uprights is placed on opposite sides of the table with a string drawn tightly between them over which one may sight to line up the patient exactly. The distance from the tip of the chin to the table top is measured and recorded so that, when the examination is repeated, the position of the patient can be duplicated exactly. The central ray of the tube is directed from the foot end of the table at a 35-degree angle through the orbits to the film placed at a level above the patient's head.

On the finished radiograph, the lead dot overlying the exophthalmic eye will be projected at a higher level than that over the normal eye. It may also be displaced laterally or medially. Because of the amount of distortion, the measured displacement represents a magnification of four to one, so that a 2-mm displacement in comparison to the opposite eye represents

about 0.5 mm of exophthalmos. This method therefore is quite precise. It does not measure the exact amount of exophthalmos, but it does give the relative degree.

The diagrams included with the article are far more explanatory than any verbal description of the method.

BERNARD S. KALAVJIAN, M.D.

**Entrapment of Barium Paste in the Piriform Sinus: A Sign of Paralysis of the Glossopharyngeal Nerve.** P. Marquès *J de radiol et d'électrol* 26, 47-48, 1944-45.

Paralysis of the glossopharyngeal nerve, which is rarely seen by itself, is manifested by the following triad of symptoms: non-painful dysphagia, displacement toward the affected side of the posterior wall of the pharynx during attacks of nausea, disturbance of taste localized to the base of the tongue. A distinctive radiologic sign described by Calvet, and known by his name, consists in entrapment of barium in the piriform sinus.

In a normal subject, at the moment of swallowing, the contraction of the superior constrictors of the pharynx, and, more especially, the shortening of the pharynx and the ascent of the larynx due to the pharyngopalatini and the stylopharyngeus muscles, accelerate the bolus on its way to the esophagus. In paralysis of the glossopharyngeal nerve, this movement is absent, or is faulty, and one sees the barium pouring over the base of the tongue, arrested in part at the valleculae, then pocketed in the piriform sinus. If the paralysis is confined to one side, the sign is correspondingly unilateral; if paralysis is bilateral, the sign is bilateral. The author adds that the sign is not positive in pseudobulbar paralysis, but is an early manifestation in a true bulbar paralysis.

PERCY J. DELANO, M.D.

## THE CHEST

**Evaluation of the Comparative Efficiency of Various Methods of Mass Radiography** Charles F. Behrens, Herman E. Hilleboe, Harold F. A. Long, and J. Yerushalmy *U S Nav M Bull* 45, 635-646, October 1945.

This article goes into the variable factors in conducting a survey bringing out the methods of handling a comparative study with special reference to (1) inter-individual variations in reading the standard (2) inter-individual variations for each of the techniques under investigation—as 35-mm., 70-mm., and 4 X 5-inch stereoscopic celluloid films and 14 X 17-inch paper films, compared with 14 X 17-inch celluloid film as a control (3) intra-individual variations in reading the standard, (4) individual scores for each technique for each reader (5) inter-individual variations of the scores of different readers.

'It is apparent from the foregoing' say the authors 'that the definitive analysis involved in a comparative study of various techniques of mass radiography includes many difficult and elaborate operations.' [The whole problem is obviously self-limited by the skills of the so-called readers', in other words, the value of a survey is only as good as the individual men conducting it, reducing it to a statistical study is difficult at best and

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HENRY K TAYLOR, M D

**Eosinophilic Lung (Tropical Eosinophilia)** Philip J Hodes and Francis C Wood *Am J M Sc* 210 288-295, September 1945

Eosinophilic lung is characterized by fever, cough, asthma, bronchopulmonary changes demonstrable on the roentgen film, and eosinophilia. The disease, common in India, has been known to develop in Europeans, and may involve American troops returning from the Orient.

Nothing definite is known concerning the etiology of this disease. Weingarten (*Lancet* 1 103, 1943) has never seen a case in a person who has always lived in a dry climate. All of his patients lived near the sea. The asthmatic manifestations and the eosinophilia suggest an allergic factor. There is no seasonal incidence, nor do race, age, diet, alcohol, or social status seem significant.

The disease commonly begins with lassitude, anorexia and slight fever, which may rise to  $101^{\circ}$  in the evening. During the second week, a dry hacking cough, which is worse at night, usually develops. The cough becomes more severe as time goes on. Many of the patients have symptoms of asthmatic bronchitis. Indeed, the disease may start with an asthmatic attack. The patients who suffer nocturnal distress frequently are comfortable during the day. After several weeks the fever subsides, weakness gradually disappears, and there is no further loss in weight. The bronchopulmonary symptoms usually persist and become chronic if treatment is not instituted.

Physical examination reveals slight hyperresonance and sibilant and sonorous as well as occasional crepitant râles. During the febrile period, the spleen is moderately enlarged in one half of the cases. The most striking feature is the massive eosinophilia, which may constitute as much as 92 per cent of a high white cell count.

Roentgenograms made at the end of the second week show bilateral pulmonary mottling, consisting of lesions which vary from 2 to 5 mm in diameter and have a dense center and an ill-defined blurred periphery. These are not pathognomonic. This stage rarely lasts more than four weeks. Thereafter the lesions regress, leaving only prominent hilar and truncal markings. One may see clinical findings without roentgen findings, or roentgen findings without clinical signs. The disease may be related to Löffler's pneumonia.

Treatment is by intravenous neocarsphenamine every fourth day for six injections.

Two cases are described in detail.

BENJAMIN COPELAND, M D

**Contribution to the Study of Intrathoracic Metastases in Cancer of the Pharynx.** Guy Morin *J de radiol et d'électrol* 26 117-124, 1944-45

This study is based upon a series of 1,334 patients with primary neoplasms of the pharynx (hypopharynx, rhinopharynx, and oropharynx) treated at the Curie Foundation, by Coutard and Baclesse, between 1920 and 1938. Pathologically, the tumors were of two types, epitheliomas and lymphosarcomas, the epitheliomas outnumbering the lymphosarcomas almost 10 to 1. Of the entire series 43, or 3.2 per cent, metas-

tasized to the thorax (including the lung parenchyma, pleura, and mediastinum). The incidence of thoracic metastases for each of the tumor types was approximately the same: 3.1 per cent for the epitheliomas and 3.7 per cent for the lymphosarcomas. Local extension, at least to some degree, occurred in all cases, and in all except 2 (both epitheliomas) there was lymph node involvement. As to whether the route of dissemination was by the blood stream or the lymphatics, the author wisely offers only conjecture in each case.

The average interval between the discovery of metastases and death averaged eight and a half months. The physical signs and symptoms appearing with the metastases are discussed, and the radiologic manifestations are described and illustrated by reproductions of films. A frequent form was the multiple nodular type familiar in many metastatic processes, for which the French have a very descriptive term, *l'aspect de ballonnet*. Large single metastatic lesions are also shown, circular or oval in form, which in the anteroposterior view might well suggest a primary growth, even a benign tumor, as a teratoma, or one well walled off, as a neuroblastoma. Pleural effusions, milary lymphogenous dissemination, and hilar node clusters are frequently evident.

Among other points, the author emphasizes the frequency of clinically latent metastases demonstrable roentgenographically and the fact that metastasis may occur following apparent cure of the primary neoplasm.

PERCY J DELANO, M D

**Tumour-Simulating Intrathoracic Heterotopia of Bone Marrow.** Erik Ask-Upmark *Acta radiol* 26 425-430, Aug 31, 1945 (In English)

Massive deposits of heterotopic bone marrow simulating tumor growth have been observed occasionally in the retroperitoneal space, in some few instances in the thoracic cavity, and once within the cranial cavity. The author reports a case of intrathoracic localization. His patient was a 70-year-old female with a history of anemia for thirty-six years and epigastric pain and increasing jaundice for seven years. The patient presented the picture of hemolytic jaundice, with an enlarged spleen and a somewhat hyperplastic bone marrow. Roentgenographic examination of the chest revealed an elliptical shadow  $4.5 \times 7$  cm just to the right of the seventh, eighth, and ninth thoracic vertebrae. There was no apparent involvement of the vertebrae or ribs. The skull and pelvic bones showed areas of decreased density. The remaining skeletal examination was negative. Because of the history of hemolytic jaundice, the mass was considered to represent heterotopic bone marrow. The diagnosis, made four years before the death of the patient, is said to be the first to be established antemortem.

At necropsy the spleen was found to be considerably enlarged, and the malpighian corpuscles were difficult to identify. In the thoracic cavity were two large paravertebral masses closely adherent to the vertebral column. These were soft, with a rather even surface, and bluish-red in color. Microscopically, this tissue was similar to hyperactive bone marrow.

Eight cases from the literature with similar post mortem findings are reviewed. The author concludes that in the presence of hemolytic jaundice with an intrathoracic paravertebral tumor, the possibility of heterotopic bone marrow should be considered.

J H WEISS, M D



**Atrial Septal Defect. Studies of Hemodynamics by the Technique of Right Heart Catheterization** Emmett S Brannon, H Stephen Weens, and James V Warren *Am J M Sc* 210 480-491, October 1945

In normal subjects, the oxygen content of the right atrial blood has been found, by means of right heart catheterization, to be somewhere between that of the superior and inferior vena cava, since the atrial blood is a mixture of the blood from these two vessels. In cases of atrial septal defect, the oxygen content of the right atrial blood is higher than that of the venae cavae, confirming a left-right shunt.

By means of the catheter, blood samples for analysis were obtained from the right atrium, the inferior and superior vena cava, and, in one case in which the catheter slipped through the interatrial septal defect, from the left atrium. The position of the opaque catheter was always checked by means of fluoroscopy. Arterial blood was obtained from the femoral artery. Direct blood pressure readings were made, oxygen consumption was determined, and the cardiac output calculated. Up to the time of the report the authors had performed 120 catheterizations without untoward incident.

Of 4 adults with atrial septal defects, one denied symptoms referable to the cardiovascular system, all had signs of cardiac enlargement. Three had symptoms of congestive failure on admission. In all a murmur was heard along the left border of the sternum from the 2nd to the 5th intercostal space. In all, the pulmonic second sound was accentuated. All showed evidence of right axis deviation on electrocardiographic tracings.

The common, but not characteristic, roentgenologic features were marked dilatation and increased pulsation of the pulmonary artery, shortening of the aortic knob, and enlargement of the right heart chambers. The heart in atrial septal defect is usually larger than in patent ductus arteriosus, but the differentiation depends largely on the history and the physical signs. The size of the heart in each of the cases which are presented by the authors decreased with treatment of congestive failure. The interatrial shunt is only occasionally demonstrated angiocardographically, and then with difficulty and not unequivocally. The technique of right heart catheterization has permitted the exclusion of the diagnosis of atrial septal defect in cases showing hypertrophy of the right ventricle and prominence of the pulmonary artery due to other causes.

In 4 patients in whom there was clinical evidence of atrial septal defect, the average oxygen content of the right atrial blood was higher than that in the superior or inferior vena cava. Although the intra-atrial pressures on the two sides of the heart do not differ greatly, the right is pumping at least twice as much as the left.

A satisfactory explanation for the left-right shunt has not been offered. It has been suggested that this may occur because of the relative cephalad position of the left atrium as compared with the right. There was no change in the oxygen concentration in the atrial blood when the patient was studied in the head-down position.

In one patient evidence indicated that a difficulty in oxygenating blood rather than the shunt was producing symptoms. It has been noted previously that sclerotic changes and thrombosis of the pulmonary vessels may complicate an atrial septal defect.

BENJAMIN COLEMAN, M D

**Calcification in the Ductus Arteriosus** Arthur E Childe and Eleanor R Mackenzie *Am J Roentgenol* 54 370-374, October 1945

Postmortem examination of a nine-month old infant revealed a calcified area within the remnants of the ductus arteriosus sufficiently extensive to be readily demonstrated in a roentgenogram of the specimen. No chest films had been made prior to death. Since this occurrence, the authors have studied 3 other cases in which roentgen examination of the chests of living infants have shown calcified shadows corresponding in position to the ductus arteriosus. The calcified shadows have been small, linear or crescentic in shape, and have required roentgenograms with sharp detail for their visualization. In only one case could the shadow be observed on roentgenoscopy and then it was seen to pulsate with the heart and vascular shadows. In none of the cases was there any evidence of cardiovascular abnormality. The condition does not appear to have any clinical significance but needs to be differentiated from tuberculous calcifications. Calcification has not been observed by the authors in any of their 18 cases of patent ductus arteriosus which have been operated upon.

L W PAUL, M D

## THE DIGESTIVE SYSTEM

**Abnormal Esophageal Communications Their Types, Diagnosis, and Therapy** Osler A Abbott *J Thoracic Surg* 14 382-392, October 1945

In this discussion of abnormal esophageal communications, only acquired fistulas are included. Their causes in order of importance are carcinoma, inflammatory diseases, and trauma. Syphilis, tuberculosis, and empyema of the pleural cavity are the commonest inflammatory lesions. The most usual site for the fistula is from the esophagus into the trachea or bronchi. Other routes are to the skin, pleural cavity, and pericardial cavity and mediastinum.

The literature is reviewed and 23 additional cases are reported, in 6 of which the fistula was successfully closed. There have been 15 successfully treated cases reported by others.

The occurrence of paroxysms of coughing on eating, particularly on taking fluids, is the most dramatic and suggestive symptom. The diagnostic measure of greatest value is x-ray demonstration of the fistula, preferably with iodized oil rather than barium, to prevent irritation of the lung. Injection of methylene blue followed by bronchoscopy or demonstration of the dye elsewhere is also a valuable procedure.

The fundamentals of therapy are maintenance of nutrition and good drainage. Although this is a serious condition, it should not be looked upon as hopeless.

HAROLD O PETERSON, M D

**Cardio-Esophageal Relaxation.** Morris Berk *Gastroenterology* 5 290-298, October 1945

Cardio-esophageal relaxation, or insufficiency of the cardia, is an abnormality of unknown etiology in which the gastric contents regurgitate passively into the esophagus through a patulous cardiac sphincter. The chief symptoms are epigastric distress and a lumpy sensation at the lower sternum. In the majority of cases insufficiency of the cardia is associated with other diseases in or outside of the gastro-intestinal tract. Its chief importance lies in the fact that it

In the author's case there was an unquestionable allergic background  
HENRY K. TAYLOR, M D

**Eosinophilic Lung (Tropical Eosinophilia)** Philip J Hodges and Francis C Wood *Am J M Sc* 210 288-295, September 1945

Eosinophilic lung is characterized by fever, cough, asthma, bronchopulmonary changes demonstrable on the roentgen film, and eosinophilia. The disease, common in India, has been known to develop in Europeans, and may involve American troops returning from the Orient.

Nothing definite is known concerning the etiology of this disease. Weingarten (*Lancet* 1 103, 1943) has never seen a case in a person who has always lived in a dry climate. All of his patients lived near the sea. The asthmatic manifestations and the eosinophilia suggest an allergic factor. There is no seasonal incidence, nor do race, age, diet, alcohol, or social status seem significant.

The disease commonly begins with lassitude, anorexia and slight fever, which may rise to  $101^{\circ}$  in the evening. During the second week, a dry hacking cough, which is worse at night, usually develops. The cough becomes more severe as time goes on. Many of the patients have symptoms of asthmatic bronchitis. Indeed, the disease may start with an asthmatic attack. The patients who suffer nocturnal distress frequently are comfortable during the day. After several weeks the fever subsides, weakness gradually disappears, and there is no further loss in weight. The bronchopulmonary symptoms usually persist and become chronic if treatment is not instituted.

Physical examination reveals slight hyperresonance and sibilant and sonorous as well as occasional crepitant râles. During the febrile period, the spleen is moderately enlarged in one-half of the cases. The most striking feature is the massive eosinophilia, which may constitute as much as 92 per cent of a high white cell count.

Roentgenograms made at the end of the second week show bilateral pulmonary mottling, consisting of lesions which vary from 2 to 5 mm in diameter and have a dense center and an ill-defined blurred periphery. These are not pathognomonic. This stage rarely lasts more than four weeks. Thereafter the lesions regress, leaving only prominent hilar and truncal markings. One may see clinical findings without roentgen findings, or roentgen findings without clinical signs. The disease may be related to Löffler's pneumonia.

Treatment is by intravenous neocarsphenamine every fourth day for six injections.

Two cases are described in detail.

BENJAMIN COLEMAN, M D

**Contribution to the Study of Intrathoracic Metastases in Cancer of the Pharynx.** Guy Morin *J de radiol et d'électrol* 26 117-124, 1944-45

This study is based upon a series of 1,334 patients with primary neoplasms of the pharynx (hypopharynx, rhinopharynx, and oropharynx) treated at the Curie Foundation, by Coutard and Baclesse, between 1920 and 1938. Pathologically, the tumors were of two types, epitheliomas and lymphosarcomas, the epitheliomas outnumbering the lymphosarcomas almost 10 to 1. Of the entire series 43, or 3.2 per cent, metas-

tasized to the thorax (including the lung parenchyma, pleura, and mediastinum). The incidence of thoracic metastases for each of the tumor types was approximately the same: 3.1 per cent for the epitheliomas and 3.7 per cent for the lymphosarcomas. Local extension, at least to some degree, occurred in all cases, and in all except 2 (both epitheliomas) there was lymph node involvement. As to whether the route of dissemination was by the blood stream or the lymphatics, the author wisely offers only conjecture in each case.

The average interval between the discovery of metastases and death averaged eight and a half months. The physical signs and symptoms appearing with the metastases are discussed, and the radiologic manifestations are described and illustrated by reproductions of films. A frequent form was the multiple nodular type familiar in many metastatic processes, for which the French have a very descriptive term, *lâcher de billes*. Large single metastatic lesions are also shown, circular or oval in form, which in the anteroposterior view might well suggest a primary growth, even a benign tumor, as a teratoma, or one well walled off, as a neuroblastoma. Pleural effusions, milinary lymphogenous dissemination, and hilar node clusters are frequently evident.

Among other points, the author emphasizes the frequency of clinically latent metastases demonstrable roentgenographically and the fact that metastasis may occur following apparent cure of the primary neoplasm.

PERCY J. DELANO, M D

**Tumour-Simulating Intrathoracic Heterotopia of Bone Marrow.** Erik Ask-Upmark *Acta radiol* 26 425-440, Aug 31, 1945 (In English)

Massive deposits of heterotopic bone marrow simulating tumor growth have been observed occasionally in the retroperitoneal space, in some few instances in the thoracic cavity, and once within the cranial cavity. The author reports a case of intrathoracic localization. His patient was a 70-year-old female with a history of anemia for thirty-six years and epigastric pain and increasing jaundice for seven years. The patient presented the picture of hemolytic jaundice, with an enlarged spleen and a somewhat hyperplastic bone marrow. Roentgenographic examination of the chest revealed an elliptical shadow  $4.5 \times 7$  cm just to the right of the seventh, eighth, and ninth thoracic vertebrae. There was no apparent involvement of the vertebrae or ribs. The skull and pelvic bones showed areas of decreased density. The remaining skeletal examination was negative. Because of the history of hemolytic jaundice the mass was considered to represent heterotopic bone marrow. The diagnosis, made four years before the death of the patient, is said to be the first to be established antemortem.

At necropsy the spleen was found to be considerably enlarged, and the malpighian corpuscles were difficult to identify. In the thoracic cavity were two large paravertebral masses closely adherent to the vertebral column. These were soft, with a rather even surface, and bluish-red in color. Microscopically, this tissue was similar to hyperactive bone marrow.

Eight cases from the literature with similar post mortem findings are reviewed. The author concludes that in the presence of hemolytic jaundice with an intrathoracic paravertebral tumor, the possibility of heterotopic bone marrow should be considered.

J H WEISS, M D

**Multiple Cancer of the Colon** Olle Olsson *Acta radiol* 26 415-424, Aug 31, 1945 (In German)

The author reports five cases of multiple cancer of the colon. The difficulties encountered in the roentgenological diagnosis are discussed in detail, and it is conceded that a final decision as to true tumor multiplicity is frequently impossible. As a practical conclusion it is demanded that neither the radiologist nor the surgeon content himself with partial colon exploration but, in each individual case, look for and exclude multiple tumor occurrence.

ERNST A. SCHMIDT, M.D.

**Hernia of the Ileum Through a Hole in the Transverse Mesocolon** Report of a Case with Symptoms and Radiological Appearances Simulating a Meckel's diverticulum. Rodney Smith *Brit J Surg* 33 87-188, October 1945

A man aged 30 gave a history of four attacks of abdominal pain and vomiting over a period of eight months following operation for an umbilical abscess. Each attack had consisted in typical small intestinal colic occurring intermittently over a period of several days, accompanied by severe vomiting, abdominal distention, anorexia, and general malaise. Physical examination was essentially negative. The history, however, suggested some form of intermittent obstruction of the lower small intestine. Radiological study following a barium meal revealed a normal stomach and duodenum. At the end of two and a half hours the cecum was in the ileum and ascending colon. At this time a sausage-shaped segment of small intestine was observed extending medially from the region of the hepatic flexure. At the end of five hours the segment of small intestine was still filled, while the large intestine was well outlined and distinct from it. Subsequent examination showed the segment completely emptied of barium. A diagnosis was made of Meckel's diverticulum, with the segment of intestine bearing it fixed in an abnormally high position in the abdomen by inflammatory adhesions from the previous abscess operation, however, revealed no evidence of bands or adhesions but showed a circular hole in the transverse mesocolon about 1 inch from the hepatic flexure. Through this a loop of the terminal ileum had herniated. The defect was corrected and the patient made an uneventful recovery.

MAX CLIMAN, M.D.

**Radiographic Diagnosis of Hernia into the Lesser Peritoneal Sac Through the Foramen of Winslow** Report of a Case. M. S. Hollenberg *Surgery* 18 498-502, October 1945

The author reports what is apparently the first instance of preoperative diagnosis of hernia into the lesser peritoneal sac through the foramen of Winslow. The patient was a 76-year-old white male complaining of acute epigastric pain. He had enjoyed good health until the year before, when he began to suffer recurrent attacks of diarrhea. His acute illness began eight hours before he was seen by the author. The pain was localized in the upper part of the abdomen, with severe attacks of colic lasting about two minutes and gradually subsiding. The clinical picture was that of an acute obstruction. No peristaltic waves were visible during the colicky attacks. There was acute tenderness over the epigastric region upon palpation. There had been no vomiting, and no flatus or feces had been passed

since the onset of the illness. Epigastric resonance was marked on deep percussion and there was some fullness in the epigastrium.

Following a barium meal, two parallel crescentic outlines were demonstrated on the lesser curvature, with the stomach hugging a rounded gas-filled mass. This picture suggested to the author the possibility of a hernia into the lesser peritoneal cavity. A barium enema confirmed this impression, outlining the rectosigmoid and the descending and left half of the transverse colon, where the barium shadow abruptly ceased. The large, round, gas-filled mass hugged by the stomach was still visible, as was gas-distended bowel leaving this mass, apparently being pinched off in the region of the foramen of Winslow.

Operation revealed a large tympanic mass, over which the gastro-hepatic omentum could be moved freely. No cecum or ascending colon could be found. The tip of the appendix was located high on the right side under the liver. The right half of the transverse colon was absent. After opening the lesser omentum and deflating the cecum, the herniated bowel was easily reduced through the foramen of Winslow.

The patient died two weeks after operation from pulmonary embolism. At autopsy there was no fluid in the abdominal cavity and the foramen of Winslow was large, admitting three fingers. Numerous adhesions of the gallbladder and liver to the center of the transverse colon were present, and the right lobe of the liver was elongated and constricted, conditions which were probably responsible for the unusual hernia.

J. E. WHITELEATHER, M.D.

**Congenital Eventration of the Diaphragm** Surgical Management. J. Dewey Bisgard and George E. Robertson *Am J Surg* 70 95-99, October 1945

This is a case report of eventration of the right dome of the diaphragm in an infant, cured by operation. It is recorded because no such case was found to have been reported previously and it is suspected that some deaths among the newborn are really due to unrecognized congenital eventration of the diaphragm, which, as in this case, have a prospect of surgical cure.

Eventration is defined as an abnormally high leaf of the diaphragm as a result of paralysis, aplasia, or atrophy of the muscle fibers but with no break in continuity of the dome, a feature which serves for differentiation from diaphragmatic hernia. Eventration has been observed in patients of all ages. Most reported cases, however, are in adults, so that the authors believe the lesion may in many instances be acquired. The condition may be asymptomatic. Symptoms, when present, are of four general groups—gastric, cardiac, pulmonary, and pleuropulmonary.

Eventration is most common in the left dome of the diaphragm. Not infrequently there may be associated maldevelopments of lung, heart, or liver, failure of intestinal rotation, or unassociated congenital deformities, such as cleft palate.

The authors' patient had cyanosis and dyspnea which developed ten days following an apparently normal delivery. Feeding difficulties ensued and the child failed to gain weight. On physical examination, the right side of the chest was found to move more than the left and there was lateral retraction with inspiration. Dullness to percussion and absence of breath sounds were present below the level of the right second

may be confused with other conditions about the terminal esophagus, as hiatus hernia, diverticulum, achalasia, cancer, etc., it is probably frequently overlooked by the roentgenologist. Cardio-esophageal relaxation can usually be diagnosed by fluoroscopy, with the patient in the supine or Trendelenburg position, barium may be seen to flow passively into a dilated lower esophagus and gravitate back into the stomach when the upright position is assumed. Any procedure which increases intra abdominal pressure will aid in demonstrating the flow of barium through the incompetent sphincter.

A case of cardio-esophageal relaxation in which the roentgen diagnosis was confirmed by esophagoscopy is presented. Regurgitation and the relationship between position and the development of symptoms were outstanding in this case.

**Lymphosarcoma of the Stomach.** Leonard Cardon and Regina S Greenbaum. *Am J Digest Dis* 12: 339-344, October 1945.

The diagnosis of lymphosarcoma of the stomach is difficult to make for the following reasons: "(1) The disease is rare. (2) It mimics carcinoma or ulcer completely in the majority of cases. (3) The differential features seldom appear. (4) Some of these differential features occur also in atypical carcinoma, gastritis, syphilis and other diseases of the stomach. (5) The suggestive features may not occur until late in the disease."

Because of the possible efficacy of x-ray treatment in this type of lesion, an attempt has been made to establish diagnostic criteria by study of a proved case. The patient was a woman aged 54, who began having attacks of epigastric pain in 1930. X-ray examination of the stomach showed no lesion. Cholecystograms revealed a non-functioning gallbladder, but the patient refused operation. The attacks persisted, and in 1931 another roentgenogram showed a filling defect on the lesser curvature side of the pylorus, leading to a diagnosis of carcinoma. Operation was again refused, and three months later (February 1932) the defect was no longer demonstrable. In October 1934, an x-ray examination again showed the defect, but surgery was deferred because of an unexplained high fever. On Nov 18, 1934, the patient entered the hospital complaining of constant pain radiating from both axillae to the epigastrium, pain in the back, weakness, vomiting, and vertigo. X-ray examination at that time showed an unoperable "carcinoma" of the stomach.

"The outstanding features of the case were: fever, a mass in the abdomen resembling Riedel's lobe, a spleen whose tip was just palpable at the costal margin, tenderness over an indistinct mass in the epigastrium, an irregular, poorly filled stomach with carcinoma-like termination of the defect at the pylorus, achlorhydria, occult blood in the stool and non visualization of the gallbladder."

Death followed an exploratory laparotomy. At autopsy a primary reticulum-cell sarcoma of the stomach was found.

It is the opinion of the authors that such symptoms as the four-year duration of the disease without cachexia, the prolonged septic fever, the splenomegaly and the late appearance of occult blood in the stool, should singly or in combination lead to the suspicion of a lymphoblastoma of the stomach.

JOSEPH T. DANZER, M.D.

**Gastro-Duodenal Ulcer in Childhood.** Erik Warberg. *Acta paediat* 33: 86-97, Oct. 31, 1945. (In English.)

Ulcerations of the stomach and duodenum in children are most frequently encountered in the first year of life and around puberty. In infants, the ulcers nearly always are associated with infections, intoxications, trauma, circulatory disorders, or cachexia, but in children above five years of age the vast majority of ulcers are based on actual gastroduodenitis. The condition may manifest itself by (a) a gastroduodenal syndrome, as in adults, (b) the sudden occurrence of complications (hemorrhage or perforation), or finally and presumably most often by (c) vague and unclear characteristic symptoms.

Two cases of duodenal ulcer in girls, aged nine and eleven, are reported. The younger girl gave a history of periodic vomiting for five years, the other had suffered from vomiting for two years, with periodic pain in the epigastric region and two attacks of severe melena. In each patient, x-ray examination revealed a typical duodenal ulcer.

The author emphasizes that gastroduodenal ulcers occur more frequently in children than is generally supposed and urges x-ray examination in the presence of uncharacteristic dyspeptic symptoms.

**Case of Ileocolic Intussusception Reduced Without Operation.** Børge Faber. *Acta radiol* 26: 409-411, Aug 31, 1945. (In English.)

The author reports a case of ileocolic intussusception reduced by conservative methods. A short review of the literature is given and Hellmer (*Acta radiol* 24: 235, 1943) is quoted as presenting the only similar case on record. Faber's patient was a twenty-one-month-old boy in apparently good health until six hours before he was seen. He became suddenly ill, with intermittent attacks of vomiting and violent crying. Roentgen examination by contrast enema showed an obstruction in the region of the hepatic flexure, giving the typical radiographic appearance of intussusception. This was reduced with no difficulty, but filling of the small bowel showed a persistent picture of intussusception about 10 cm long. After four attempts with manipulation and pressure, the intussusception was released and apparently did not reform. The author claims that this case shows that some types of small bowel intussusception can be reduced conservatively.

J. H. WEISS, M.D.

**Chronic Ulcerative Colitis with Infantilism and Carcinoma of the Colon.** William E. Ricketts, Earl P. Benditt, and Walter Lincoln Palmer. *Gastroenterology* 5: 272-280, October 1945.

A case of infantilism and carcinoma of the colon in an eighteen-year-old boy who had had chronic ulcerative colitis since the age of two and a half is reported. The patient was 51 inches tall, weighed 45 pounds at death, and was underdeveloped sexually and somatically, appearing four or five years younger than his actual age. There was roentgen evidence of retarded ossification and generalized osteoporosis. Histologic examination showed the testis and epididymis to be infantile in type. The adenocarcinoma of the descending colon is interpreted as the consequence of the ulcerative colitis. Other cases of infantilism in association with ulcerative colitis are cited.

s usually either a calcified splenic cyst or an aneurysm of the splenic artery. Bruit should be heard over an aneurysm.

Usually symptoms are negligible. In the case reported, there was a complaint of dragging sensation and epigastric fullness. No palpable mass could be made out and no unusual sounds were heard over the spleen. Other findings were also essentially negative. Splenectomy, following the radiologic diagnosis, completely relieved the patient. Pathologically, the spleen was moderately enlarged, with a large oval cystic mass in the upper pole. Microscopically, the wall of the cyst was made up of dense fibrous tissue with extensive calcification. In some areas, there was flat epithelial lining, in other areas, this was absent.

BERNARD S. KALAYJIAN, M.D.

### THE MUSCULOSKELETAL SYSTEM

**Differential Diagnosis of Tuberculosis in Joints of the Extremities.** Raymond W. Lewis. *Am J Roentgenol.* 54: 329-337, October 1945.

The early work of Phemister with regard to the differential diagnosis of tuberculous and pyogenic infections of the joints is reviewed and its value confirmed. In tuberculous arthritis there is preservation of the joint space for months or years, since the cartilages, though dead, are still present to hold the bones apart. The earliest bone destruction is not on the contiguous opposing bony surfaces but about the margins of the weight-bearing surfaces. There is evidence of muscle atrophy about the joint with little tendency to repair and ankylosis. In acute suppurative arthritis there are rapid and severe osteoporosis about the joint, early destruction of cartilage, resulting in decrease in joint width, bone destruction first on the weight-bearing portions of the articular surfaces, and little, if any, atrophy of muscles. In the hips the above-mentioned criteria of tuberculosis are seldom observed, possibly because the early manifestations cannot be depicted properly in this joint. *Caries sicca* also offers diagnostic difficulties, and the diagnosis is made largely by exclusion. Diseases of the joints other than suppurative arthritis usually offer no difficulty in differentiation from tuberculosis. It may, however, be closely simulated by rare instances of joint involvement in leukemia, histoplasmosis, etc.

L. W. PAUL, M.D.

**X-Ray Examination of the Hip-Joint in Tuberculous Disease with Special Reference to the Localisation of Cavities and Tuberculous Foci.** Franklin G. Wood and M. C. Wilkinson. *Brit J Radiol* 18: 332-334, October 1945.

Serial radiographs are as essential in the treatment of tuberculosis of the hip as they are in tuberculosis of the lungs. The different phases of the disease can be demonstrated more accurately by roentgenography than by clinical methods, and, indeed the degree of calcification and re ossification occurring in the healing stage can be determined only by radiographic study. Lateral views of the hip are particularly useful but frequently are not taken. The most informative lateral view is made with the patient lying on the affected side so that the lateral aspect of the thigh is in contact with the table, the other leg being drawn backward and the pelvis rotated so as to form an angle of 65 degrees with the horizontal. Thus the head, neck and shaft of the

femur are in the true lateral position. Tomography is also of value.

SYDNEY J. HAWLEY, M.D.

**Penicillin Treatment of Acute Hematogenous Osteomyelitis.** I. W. J. McAdam. *Brit J Surg* 33: 167-172, October 1945.

A series of 40 cases of osteomyelitis treated by penicillin is discussed from two standpoints: (1) saving of life by overcoming the initial septicemia or pyemia, (2) cutting short of local infection and limiting of bone necrosis. A daily dose of 100,000 units of penicillin was used, introduced intramuscularly in 29 cases and through an intramedullary needle in 11 cases.

There are two well defined clinical types of osteomyelitis and the response to penicillin supports this classification. The first group includes patients with evidence of septicemia in addition to a local lesion of bone, the second group comprises those with a local lesion only. In this series 21 patients had a generalized infection, of these, 10 had metastatic foci and 20 had positive blood cultures. The clinical response in this group was not dramatic. The blood cultures became sterile, on an average, in three days, whereas the temperature remained raised for seven to fourteen days, finally subsiding by lysis. The second clinical type is represented by 19 patients with varying degrees of toxemia in whom the general condition was good, the blood cultures were negative, and there were no metastatic lesions. In this group, the temperature usually subsided within seven days of the institution of treatment, and general improvement was obvious before that time.

Conservative measures following control of the general infection were favored in this series, only 5 out of 32 patients with acute infections of long bones had operative treatment. Aspiration of a subperiosteal abscess alone was done in 2 of the cases treated conservatively, and in 15 cases a sternal puncture needle was inserted into the affected metaphysis for relief of intramedullary tension. Sequestrectomy was found to be unnecessary and exacerbations did not occur in any of the patients treated by aspiration and immobilization. The results of more extensive operative treatment were not encouraging. Two patients developed sequestra which required removal and had discharging sinuses after eleven and seven months, respectively. In 10 of the 40 patients, septic arthritis occurred. This is believed to be most effectively treated by aspiration of pus and local injection of penicillin into the joint cavity every second day. Aspiration of a relatively inaccessible joint is, however, not always practicable and systemic treatment has to be relied upon. There is evidence that penicillin in detectable amounts will pass from the blood stream through a synovial membrane when the joint is infected.

The outstanding radiological features in early infection are extensive decalcification, limited amount of subperiosteal bone formation, and absorption of small sequestra. Decalcification in most of the author's cases was widespread. Excessive periosteal new bone formation did not occur, nor was there wide separation of the periosteum from the cortex, presumably because bone destruction and pus formation were controlled by penicillin. Healing was demonstrated by irregular recalcification. The absence of massive sequestra facilitated early healing and the absorption of smaller sequestra resulted in localized areas of sclerosis. The limited periosteal bone formation maintained a moderately regular outline of the bone with little deformity.

rib anteriorly and in the upper two thirds of the left chest. Roentgenograms of the chest showed the right dome of the diaphragm to be elevated to the fourth rib posteriorly. There was increased density of the right lung, probably from compression, and an enlarged heart shadow displaced to the left, in contact with the left costal border. The liver shadow was displaced upward and its lower border was above the costal margin.

A diagnosis of either eventration or hernia was made and exploration was undertaken via an intrathoracic approach. The right dome of the diaphragm was found to be intact, its apex extending to the second rib anteriorly. Its excursion, although negligible, was not paradoxical and it consisted obviously of muscle. By plication, the dome of the diaphragm was shortened and brought down to the level of the tenth rib. The postoperative course was not unusual. There was complete relief of dyspnea and cyanosis, and seven months later respirations were normal and both lungs were completely aerated. Indeed, the infant appeared to be quite healthy, though the right dome of the diaphragm was still one interspace higher than the left.

The authors believe that this case was probably more amenable to surgery than some because the diaphragm contained muscle and substance in which sutures would be retained against tension. R. E. BOOTH, M.D.

#### Dynamics of Biliary Drainage Its Relation to Cholangitis and Pancreatitis from Stricture of the Ampulla of Vater John M. McGowan Surgery 18 470-478, October 1945

The poor results following biliary surgery can be explained on two bases: an incorrect preoperative diagnosis and failure on the part of the surgeon to pay proper attention to the physiology of the biliary and pancreatic systems following removal of the diseased gallbladder. The postoperative care of the patient who has undergone a cholecystectomy begins in the operating room. When the common bile duct has been opened for any of the generally accepted indications, a T tube should be inserted for prolonged drainage. Besides its therapeutic effect this procedure makes possible postoperative studies of the biliary and pancreatic systems.

T-tube studies are usually begun two weeks after operation and consist in pressure determinations and roentgenologic examination. The method of intrabiliary pressure determinations has been described elsewhere (McGowan *et al.* J. A. M. A. 106 2227, 1938. Abst. in Radiology 28 380, 1937). Excessive pressure (over 30 mm. of water) may be due to spasm, stricture, edema, pancreatitis or stones. In the case of spasm, the pressure is promptly reduced by amyl nitrite inhalation. Cholangiographic studies will determine whether or not there is obstruction from pancreatitis, stones, or stricture.

When the common bile duct is perfused with saline solution at increasing pressures, there comes a point when the patient experiences a sense of discomfort. This point, which is referred to as the "perfusion pain level," is frequently around 70 mm. of water three weeks after operation. With continued T-tube drainage, the bile duct becomes more resistant to pressure, so that after two or three months it will tolerate pressures of as high as 500 to 700 mm. of water before pain is produced. If the T tube is removed while the pain level is still low, one may expect continued pain. If,

on the other hand, the pain level is as high as 500 mm. of water, postcholecystectomy pain is not to be expected, since the secretion pressure of the liver is only 300 mm.

To determine the amount of pressure at which duodenal spasm will occur, the patient is given 1/6 grain of morphine. This procedure is also an index of the possibility of postcholecystectomy pain. If the pressure produced by the morphine spasm is low, the patient should not suffer from biliary dyskinesia; if, however, it is as high as 300 mm., attacks of pain may be expected.

For roentgen study of the biliary tract, diodrast may be injected through the T tube into the common duct. The relation between the biliary tract and duodenum may be studied at the same time by injecting barium into the duodenum through an indwelling duodenal tube. A series of three films are usually taken, one with the patient in the resting state, one following injection of morphine by ten minutes, and a third following deep inhalation of amyl nitrite by one minute.

In view of his observations in several hundred cases, the author concludes that the T tube should not be removed until the resting intrabiliary pressure is 30 mm. or less of water, the perfusion pain level is 300 mm. or more, and roentgen studies of the common duct show absence of obstruction to the flow of bile into the duodenum. Two weeks following operation, the T tube should be clamped at increasing intervals, starting with half an hour twice daily and increasing by one hour per day. When the tube is being clamped off twenty-four hours of the day, one should wait at other three weeks with a symptom free patient before the tube is removed.

A case is recorded, with reproductions of combined cholangiograms and duodenograms made following cholecystectomy and exploration of the common duct. In this case stricture of the ampulla of Vater is believed to have produced a regurgitation of bile into the pancreatic duct and pancreatitis. Pancreatitis then produced obstruction to the common bile duct and gallbladder resulting in cholangitis and cholecystitis. The immediate postoperative course was favorable, but ten days after continuous clamping of the T tube there was a recurrence of pain, with chills and fever. The tube was reopened and the symptoms were relieved. Spasm of the duodenum was considered of no significance in this case since the common bile duct and pancreatic duct entered the duodenal wall through separate tunnels opening into the ampulla of Vater inside the duodenum. Incidentally, the patient lived in a malaria region, and periodic attacks of chills and fever preceding operation were attributed, probably incorrectly, to malaria. J. E. WHITELEATHER, M.D.

#### THE SPLEEN

Calcified Cyst of the Spleen Report of a Case, with Review of the Literature Edwin M. Jameson and Orland F. Smith U. S. Nav. M. Bull. 45 537-541 September 1945

Cysts of the spleen of any type are rare and calcified cysts are extremely rare. This report presents a case of the latter type observed in a naval hospital, in which the diagnosis was made radiologically. The author quotes Snoke (Am. J. M. Sc. 206 726, 1943. Abst. in Radiology 43 95, 1944) as stating that any large anular calcification in the left upper abdominal quadrant

is usually either a calcified splenic cyst or an aneurysm of the splenic artery. Bruit should be heard over an aneurysm.

Usually symptoms are negligible. In the case reported, there was a complaint of dragging sensation and epigastric fullness. No palpable mass could be made out and no unusual sounds were heard over the spleen. Other findings were also essentially negative. Splenectomy, following the radiologic diagnosis, completely relieved the patient. Pathologically, the spleen was moderately enlarged, with a large oval cystic mass in the upper pole. Microscopically, the wall of the cyst was made up of dense fibrous tissue with extensive calcification. In some areas, there was flat epithelial lining, in other areas, this was absent.

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**Penicillin Treatment of Acute Haematogenous Osteomyelitis** I. W. J. McAdam. *Brit J Surg* 33: 167-172, October 1945.

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There are two well defined clinical types of osteomyelitis and the response to penicillin supports this classification. The first group includes patients with evidence of septicemia in addition to a local lesion of bone, the second group comprises those with a local lesion only. In this series 21 patients had a generalized infection, of these, 10 had metastatic foci and 20 had positive blood cultures. The clinical response in this group was not dramatic. The blood cultures became sterile, on an average, in three days, whereas the temperature remained raised for seven to fourteen days, finally subsiding by lysis. The second clinical type is represented by 19 patients with varying degrees of toxemia in whom the general condition was good, the blood cultures were negative, and there were no metastatic lesions. In this group, the temperature usually subsided within seven days of the institution of treatment, and general improvement was obvious before that time.

Conservative measures following control of the general infection were favored in this series, only 5 out of 32 patients with acute infections of long bones had operative treatment. Aspiration of a subperiosteal abscess alone was done in 2 of the cases treated conservatively, and in 15 cases a sternal puncture needle was inserted into the affected metaphysis for relief of intramedullary tension. Sequestrectomy was found to be unnecessary and exacerbations did not occur in any of the patients treated by aspiration and immobilization. The results of more extensive operative treatment were not encouraging. Two patients developed sequestra which required removal and had discharging sinuses after eleven and seven months, respectively. In 10 of the 40 patients, septic arthritis occurred. This is believed to be most effectively treated by aspiration of pus and local injection of penicillin into the joint cavity every second day. Aspiration of a relatively inaccessible joint is, however, not always practicable and systemic treatment has to be relied upon. There is evidence that penicillin in detectable amounts will pass from the blood stream through a synovial membrane when the joint is infected.

The outstanding radiological features in early infection are extensive decalcification, limited amount of subperiosteal bone formation, and absorption of small sequestra. Decalcification in most of the author's cases was widespread. Excessive periosteal new bone formation did not occur, nor was there wide separation of the periosteum from the cortex, presumably because bone destruction and pus formation were controlled by penicillin. Healing was demonstrated by irregular recalcification. The absence of massive sequestra facilitated early healing and the absorption of smaller sequestra resulted in localized areas of sclerosis. The limited periosteal bone formation maintained a moderately regular outline of the bone with little deformity.

In this series of 40 patients treated with penicillin there was only one death, despite the fact that 19 of these patients had a staphylococcal septicemia, 9 had metastatic bone lesions, and 10 had septic arthritis. An excellent table is appended, giving details of treatment of the entire series.

MAX CLIMAN, M D

**Brodie's Abscess Two Case Reports** James W Downey and Harold E Simon *Am J Surg* 70 86-94, October 1945

Brodie's abscess is a well localized chronic or subacute, non specific pyogenic abscess, usually involving the juxta epiphyseal regions of long bones. It is often entirely overlooked or wrongly diagnosed. Prompt response to treatment makes early diagnosis essential.

Two cases are presented. In one the abscess was in the trochanteric area of the left femur, in the other in the lower end of the right radius. The characteristic symptoms are pain and bony enlargement, which may be present weeks to years before the underlying lesion is recognized. The pain is worse with activity or atmospheric changes and is usually more severe at night. Effusion into the adjacent joint is not infrequently observed. Examination reveals a fusiform swelling, and localized tenderness is frequently elicited. The soft tissues are characteristically not involved, and the spontaneous development of a draining sinus is rare. Shortening of the extremity may occur rarely in the young, more rarely, lengthening is observed. Early diagnosis depends upon the roentgen demonstration of a small area of decreased density, with slight thickening of the surrounding bone, usually near the epiphysis of a long bone. Later the cavity becomes clear-cut and the circumference of the bone is increased. The differential diagnosis must take into consideration sarcoma, chronic sclerosing osteitis, bone cysts, tuberculosis, and syphilitic osteitis and periostitis.

Brodie's abscess occurs predominantly in males during the age of greatest physical activity, suggesting trauma as a contributing factor. The significance of trauma, however, is questionable. The upper and lower ends of the tibia are the sites most frequently involved, next in order are the femur, humerus, and radius. The frequency of acute infections preceding Brodie's abscess is striking, the identical organism being recovered from the abscess in many instances. Typhoid, paratyphoid, *B coli* streptococcus, and staphylococcus infections are specifically mentioned.

The present methods of treatment consist of complete excision of the cavity with saucerization and primary closure. Sulfonamides locally, frequently supplemented by systemic administration pre- and post-operatively, are indicated. A cast is usually applied for two or three weeks after operation. The prognosis is excellent.

C R PERRYMAN, M D

**Fibrous Dysplasia—A "Cystic" Lesion of Bone** Herbert M Stauffer and Patrick J Fitzgerald *U S Nav M Bull* 45 653-660, October 1945

The authors report a case under Jaffe and Lichtenstein's designation "fibrous dysplasia" (see *Arch Path* 33 777, 1942; *Abst in Radiology* 40 319, 1943).

A 20-year-old Army veteran had a dull aching pain in the right hip of six months' duration and a slight limp. The physical findings were otherwise insignificant, and laboratory tests were not remarkable. The blood serum calcium was 11.7 mg per cent and the

serum phosphorus 3.1 per cent. Roentgen examination of the hip disclosed evidence of an expansile, bone destructive lesion involving the intertrochanteric portion of the femur and the base of the femoral neck. There was localized thinning of the cortex, the periphery of which was still intact. In addition, there was a mottled, somewhat circular shadow of increased density in the central portion of the cyst like area. Other skeletal studies showed no abnormalities. Biopsy was done, and photomicrographs show the replacement of normal bone by loosely arranged fibrous connective tissue with numerous spicules of newly formed non lamellated, atypically calcified metaplastic fiber bone. The cyst was curetted and filled with bone chips from the tibia, and the patient made a good recovery.

The authors give a brief but comprehensive review of the literature, mentioning "Albright's triad" of (1) bone changes of "osteitis fibrosa," (2) cutaneous pigmentation, and (3) endocrine dysfunction, with precocious puberty in females. Neither pigmentation nor endocrine disturbance was present in the case reported here.

Differentiation of fibrous dysplasia from hyperthyroidism is based on the relatively normal calcium metabolism and the histologic examination. The latter also serves for differentiation from skeletal enchondromatosis (Ollier's disease), xanthomatous bone lesions, Paget's disease, multiple myeloma, and localized lesions such as unicameral bone cyst, giant-cell tumor, chronic osteomyelitis, enchondroma, eosinophilic granuloma, and other rarefying lesions.

There are two practical conclusions to be drawn from this paper: (1) After biopsy to discover the true nature of the disease, the lesion should be curetted out and autogenous bone chips be put in place to prevent further growth with an eventual pathologic fracture. (2) The term "cyst" as applied to these lesions is not justified even though radiographically they appear cystic. They are not true cysts but are composed of fibrous tissue with atypical bone formation and are correctly designated "fibrous dysplasia."

SYDNEY F THOMAS, M D

**On Osteoarthrosis Alkaptonurica (Ochronotica) with Description of One Case** Johan Hertzberg *Acta radiol* 26 484-490, Aug 31, 1945 (In English.)

The clinical importance of alkaptonuria with ochronosis is mainly due to the lesions it produces in the bones and joints. These were first described by Virchow in 1866. The ochronotic pigment is deposited in the articular cartilages, especially those with poor metabolism. These become black, lose their elasticity, and become brittle. Fragments of the blackened cartilage are broken off into the joint and deposited in the synovial membrane, with subsequent thickening of the membrane and finally of the entire articular capsule. In spite of some regeneration, constant wear may eventually destroy the cartilage completely. When this occurs, there are changes in the articular surface of the bone, with sclerosis and bone proliferation and subsequently bony ankylosis.

The case recorded is that of a 54-year old man who two years prior to admission began having pain in the left shoulder with stiffness. One year later he experienced the same symptoms in the right shoulder. More recently, pain and swelling had developed in the knees. Physical examination revealed atrophy of the



uscles of both shoulders, with ability to elevate the arms only to the horizontal. This movement was performed only by moving the scapula. Complete ankylosis was present in each shoulder joint. There was marked swelling of the right knee, with limitation of motion. The urine exhibited typical ochronosis. Roentgenography showed extensive deforming osteoarthrosis, with ankylosis in both shoulders. Osteoporosis and narrowing of the joint space were seen in both knees. The spine showed osteoporosis with loss of the normal lumbar lordosis. The intervertebral disks were narrowed and in some places partially absent. There is also calcification in many of the disks, and calcification of the lumbar vertebral ligaments was observed. This case shows findings similar to those previously reported in osteoarthrosis alkaptonurica. While the roentgen picture is fairly characteristic, the final diagnosis rests on the clinical symptoms and urinary findings.

J H WEISS, M D

**Osteochondritis Dissecans of Carpal Scaphoid: Report of a Case.** Paul E. McMaster and Ralph T. Flynn. U S Nav M Bull 45 742-744, October 1945. This is a report of a case of osteochondritis dissecans of the carpal scaphoid, diagnosed on the basis of the story and physical and roentgen findings.

**Polymorphous-Cell Sarcoma, the Malignant Phase of Giant-Follicle Lymphoma, with Generalized Skeletal Involvement and Multiple Pathological Fractures. Report of a Case.** William E. Kenney. J Bone & Joint Surg 27 668-673, October 1945.

The disease entity known as giant-follicle lymphoma characterized by splenomegaly and generalized lymphadenopathy. The lymph follicles show hyperplasia, which is characteristic of the disease. Malignant transformation may occur.

The present case report deals with a 77-year-old female with multiple pathological fractures on whom biopsy of a lymph node showed giant follicle hyperplasia. At autopsy the intestinal lymph nodes, the pancreas, spleen, and almost all the other bones were found to be involved by a neoplastic process, presenting at different sites microscopic features resembling giant lymph-follicle hyperplasia, Hodgkin's disease, reticulum-cell sarcoma, and polymorphous cell sarcoma. The spleen and liver were not invaded.

JOHN B. MCANENY, M D

**Internal Derangements of the Knee Joint. Diagnostic Scope of Soft Tissue Roentgen Examinations and the Vacuum Technique Demonstration of the Menisci.** Gershon-Cohen. Am J Roentgenol 54 338-347, October 1945.

Adequate study of the knee joint requires a demonstration of the soft tissues as well as the bones comprising the joint. Special techniques for soft tissue examination are not necessary if a proper light source is used in reviewing the roentgenograms. The internal meniscus may be demonstrated by traction or abduction of the leg. An anteroposterior view is made with the patient lying on the affected side with the leg extended and a sand bag under the knee, and with forcible abduction of the leg against the table top during the exposure. In normal subjects, the internal meniscus can be demonstrated in not more than 80 per cent of examinations,

the external meniscus in not more than 20 per cent. The only positive finding of value is failure of visualization of the menisci in the affected knee when they can be demonstrated on the healthy side. This usually indicates synovial effusion. A search should then be made for fractures at the attachment of the meniscus and evidences of swelling of the tibial collateral ligament, since sprain of this ligament usually occurs with internal meniscus injuries. Other conditions which can be demonstrated by roentgen examination, and which might be confused with internal derangements clinically, are discussed, including loose bodies, sprain or rupture of the tibial collateral ligament, periarticular bursitis, cysts of the menisci, and neoplasms.

L W PAUL, M D

**Derangements of the Knee Joint. Diagnostic Aid Obtained by the Roentgenologic Examination of the Soft Structures and of the Menisci Without Injection of Contrast Media.** J. Gershon-Cohen. U S Nav M Bull 45 488-499, September 1945.

This paper begins with an extensive review of the symptomatology, physical findings, and morphology of various types of injuries to the knee joint involving the cartilages and ligaments and includes a description of a vacuum technic for demonstration of the menisci (see preceding abstract). The author feels that at least three projections of the knee are desirable, the anteroposterior, the lateral, and the longitudinal. The last named is particularly suitable for a study of the patella.

**Intra-Articular Osteochondral Fractures as a Cause for Internal Derangement of the Knee in Adolescents.** Paul H. Harmon. J Bone & Joint Surg 27 703-705, October 1945.

Osteochondral fractures in the knee are believed to be frequently overlooked or discovered only after arthrotomy has been performed under a mistaken diagnosis of meniscus injury. Actually, such fractures are rather common in juveniles and adolescents following injury to the knee, particularly the patella. There is a loose body in the joint, and the patient complains of pain, swelling, and possibly locking of the joint.

Two cases are recorded here. The first patient was a 15-year-old boy who lacerated his knee in a fall. X-ray examination demonstrated a small fragment of bone in the articular space. This body was removed and found to be about three times the expected size, due to the cartilaginous covering. The fragment had been detached from the lateral femoral condyle.

The other patient was a 16-year-old girl who dislocated the patella in a fall, with resulting hemarthrosis, pain, and disability. Roentgen examination failed to demonstrate any fracture or loose body. The joint was opened five months after injury, demonstrating a definite defect in the articular surface of the patella on the medial aspect, in the process of filling-in with fibrocartilage. The loose body was found in the joint cavity and was much larger than the defect in the patella, showing that about half the latter had been filled in during the interval following the injury.

The films of the second case were reviewed after operation, and a rather indefinite soft shadow was seen in the joint cavity. The possibility of soft-tissue x-ray studies being of help in these cases is suggested.

JOHN B. MCANENY, M D

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MAX CLIMAN, M D

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A 20-year-old Army veteran had a dull aching pain in the right hip of six months' duration and a slight limp. The physical findings were otherwise insignificant, and laboratory tests were not remarkable. The blood serum calcium was 11.7 mg per cent and the

serum phosphorus 3.1 per cent. Roentgen examination of the hip disclosed evidence of an expansile, bone-destructive lesion involving the intertrochanteric portion of the femur and the base of the femoral neck. There was localized thinning of the cortex, the periphery of which was still intact. In addition, there was a mottled, somewhat circular shadow of increased density in the central portion of the cyst like area. Other skeletal studies showed no abnormalities. Biopsy was done, and photomicrographs show the replacement of normal bone by loosely arranged fibrous connective tissue with numerous spicules of newly formed non-lamellated, atypically calcified metaplastic fiber bone. The cyst was curetted and filled with bone chips from the tibia, and the patient made a good recovery.

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symptoms, and a later roentgenogram revealed little change

This type of lesion is best treated conservatively, with immobilization and physiotherapy. Partial disability is likely to be prolonged, and full function is not regained. The calcifications persist and undergo maturity or fusion. Spontaneous regression is said to occur, but it was not observed in any of the author's cases.

L. W. PAUL, M.D.

**A Case of Deformity of the Thorax, Probably Due to Congenital Malformation of the Dorsal Spine.** Risto Blo. *Acta radiol.* 26: 456-462, Aug. 31, 1945. (In German.)

The author describes the case of a 13-year-old girl with a severe deformity of the dorsal spine and one side of the thorax. The x-ray examination revealed extensive developmental defects and lack of fusion in the 4th to 8th thoracic vertebrae, resulting in kyphoscoliosis and costal abnormalities. The bone structure and the density of the affected vertebrae were normal, and there were no signs of inflammatory or malignant change.

ERNST A. SCHMIDT, M.D.

**Unilateral Hypoplasia of Lumbosacral Articular Processes.** A Case Report. Paul E. McMaster. *J. Bone & Joint Surg.* 27: 683-686, October 1945.

This case report deals with a 30-year-old man with pain in the lower back and right lower extremity. Physical findings indicated changes in the right hip and thigh, with measurable atrophy of the right gluteal, thigh, and calf muscles. Roentgen examination of the lumbosacral area showed the right side normal, but on the left the articular process between the fifth lumbar and the first sacral segments were markedly underdeveloped. The left lamina of the fifth lumbar vertebra was also hypoplastic. There was moderate haziness of both sacroiliac joints, indicating arthritic changes.

This report is believed to be the first to describe this particular change, although anatomical variations and anomalies are known to occur frequently in this region. Radiographically the changes are not well demonstrated in the anteroposterior and lateral views but are clearly seen in oblique views of the lumbosacral region.

JOHN B. McANENY, M.D.

**Sagittal Cleft (Butterfly) Vertebra.** Frederick J. Fischer and R. E. VanDemark. *J. Bone & Joint Surg.* 27: 695-698, October 1945.

This is a report of two cases of moderate developmental abnormality of a vertebral body. One patient showed mid-line separation of two unequal portions of the third lumbar body, with the larger and higher portion on the right and the smaller and shallower portion on the left, resulting in a left lumbar scoliosis. The second patient showed a division of the body of the seventh thoracic vertebra by a narrow cleft without lateral displacement of the divided parts or anterior wedging of the body. The eighth thoracic body, however, of which the anterior third was lacking, showed marked anterior wedging resulting in a definite kyphosis at this level.

The typical butterfly appearance is demonstrable in the anteroposterior view. The adjacent intervertebral spaces may be narrowed but not collapsed.

JOHN B. McANENY, M.D.

**Congenital Humeroradial Synostosis.** H. S. Murphy and C. G. Hanson. *J. Bone & Joint Surg.* 27: 712-713, October 1945.

A case of bilateral humeroradial synostosis in a newborn infant is recorded. Though an hereditary tendency has been observed in other cases of this deformity, no history of its occurrence in the past three generations was obtained in the present case. References to the rather scanty literature are appended.

**Congenital Absence of the Odontoid Process.** A Case Report. Raymond C. Scannell. *J. Bone & Joint Surg.* 27: 714-715, October 1945.

Roentgen examination of a 23-year-old soldier who had sustained an injury of the neck in wrestling revealed complete absence of the odontoid process, with abnormal mobility of the atlas on the axis in flexion and extension. The previously reported cases of this anomaly, to which references are given, came under observation because of dislocation of the atlas on the axis.

**Radiologic Approaches Necessary in the Treatment of Congenital Subluxations of the Hip, from the Surgeon's Point of View.** A. Laquerrière. *J. de radiol. et d'électrol.* 26: 48-51, 1944-45.

This paper is a résumé of one by Barcat published in 1943 in the *Revue d'orthopédie*. It discusses the radiologic diagnosis of congenital subluxation of the hip at three periods: before the child begins to walk, between the ages of eighteen months and eight years, and in older children.

Walking may be delayed as much as ten months after the usual time. In the youngest group three roentgen signs are of importance: (1) an exaggerated obliquity of the roof of the acetabulum (the angle with the horizon exceeding 35 degrees), (2) absence, or at least diminution in size, of the capital epiphysis, which normally appears between the sixth and twelfth months, usually about the eighth, (3) displacement outwards and upwards of the upper end of the femur, the so-called "lobster claw" sign.

In children from a year and a half to eight years old, films of both hips are indispensable, as incipient and minimal luxations may otherwise escape notice. The clinical and radiologic signs which may occur at this age are enumerated. Arthrography following injection of a contrast medium may be useful. It is less essential in the eight- to fifteen-year-old group.

The paper is illustrated by roentgenograms. Some might take issue with the author's interpretation of one of these as "bilateral subluxation." In this, the acetabulum has a steep slope—what many American radiologists would designate as a "pre luxation stage"—but the heads are certainly not out of the acetabula.

In cases which do not easily lend themselves to closed reduction, the shelf operation is considered the procedure of choice.

PERCY J. DELANO, M.D.

## THE GENITO-URINARY SYSTEM

**Use of the Antidiuretic Property of Pitressin in Excretory Pyelography.** Robert Lich, Jr., and Paul J. Lewis. *J. Urol.* 54: 400-402, October 1945.

The preparation of patients for intravenous urography can be reduced to a minimum by administering pitressin in doses of 0.5 c.c. (10 units) subcutaneously.

**Aseptic Necrosis of the Astragalus Following Arthrodesing Procedures of the Tarsus** Frederick M Marek and Albert J Schein J Bone & Joint Surg 27 587-594 October 1945

The blood supply of the astragalus is derived chiefly from the anterior tibial artery. Authorities differ on minor details, but there is quite common agreement that the nutrient vessels enter the bone at the neck, a rather "precarious" location. It is not surprising, therefore, that procedures involving extensive resection of the head and neck of the astragalus for the correction of foot deformities should be followed by aseptic necrosis. Mention of this complication seems, however, to be lacking in the literature, though its occurrence after fractures and fracture dislocations is well known.

The authors have encountered aseptic necrosis of the astragalus 5 times in a series of 81 cases in which wide resection of the head and neck was done. Lesser degrees of increased density and temporary mottling of the body were observed in other cases, but these changes did not persist and did not necessitate limitation of weight bearing. The 5 case histories are presented, and roentgenograms illustrating their course are reproduced. An additional case in which necrosis developed following fracture is included for comparison.

The conclusion is reached that where extensive resection is necessary for the correction of foot deformities, it would seem advisable to remove bone from the scaphoid or cuneiform rather than from the astragalus. In any event, postoperative roentgenograms should be watched for evidence of aseptic necrosis. Should it occur, weight-bearing must be avoided for six to nine months in order to prevent collapse of the bone and eventual development of a secondary osteoarthritis of the ankle joint. JOHN B McANENY, M D

**Metatarsal March (Fatigue) Fractures** Albert L Leveton Am J Surg 70 49-57, October 1945

The author reports 259 cases of march fracture of the metatarsals which constituted 2.35 per cent of the orthopedic cases seen at a station hospital during a period of nine months. He considers it to be an occupational disease associated with military training and extremely rare in civilian life.

Primary importance is attached to fatigue of the peroneus longus and tibialis posterior muscles. The tendons of these muscles form a sling which assists in the support of the long plantar arch. None of the fractures occurred in association with marked degrees of pes planus and only 14 in pes planus of second degree. The atavistic foot is not believed to play an important predisposing role in these fractures, although in only 64 of the cases was there conformity to the "normal" foot, in which the five metatarsal bones are arranged in parallel formation with the head of the first metatarsal on the same transverse plane or even a little more distal than that of the second. If the second metatarsal is longer and protruded beyond the other segments, it was apt to be the site of fracture, but this did not hold true in fractures of the third metatarsal. The author does not believe that age or pre-induction occupation are contributing factors since the age distribution of his cases coincided with that of the station population in general. 53 per cent had followed a sedentary occupation, 47 per cent an active occupation. Most fractures occurred during the second to fourth month of training when the program was most strenuous.

The right foot was involved 154 times and the left 105 times. The fractures occurred in the second and third metatarsals 228 times. Twenty-three cases of multiple fractures were found and in 10 of these the fractures were bilateral. The second and third metatarsals again were most frequently involved. The fracture was complete in 199 cases and incomplete in 60 cases. In 35 there was some displacement.

The onset of clinical symptoms usually followed a long or forced march and was acute or insidious. The patient was usually able to continue with his march, and the average interval between the onset of symptoms and hospitalization was 15.4 days. Pain and swelling of the dorsum of the foot were the usual complaints. Physical examination showed point tenderness and some swelling over the involved metatarsal. Motion of the toe caused pain.

The roentgen findings vary with the age of the injury, and a negative roentgenogram is not conclusive in the presence of positive clinical findings. In such cases the author advises a recheck in about a week. Early in the first week there may be merely periosteal elevation and thickening. Following the first week there may be diffuse thickening of the periosteum or more commonly the fracture extends through the entire thickness of the bone. Large, fluffy, or cottony callus at the fracture site is one of the characteristics of metatarsal march fracture, but there is slight production of callus in fractures involving the neck. When fracture involves the first metatarsal, it occurs at the base and is of the "ice-crack" type. After four to six weeks the callus becomes organized and a fusiform swelling is present at the fracture site. Angulation is not common.

The patients are kept at bed rest for three weeks although no untoward effects were observed in a small group who were permitted to bear weight on the heel after seven to ten days. They are then placed on a reconditioning program for two to four weeks, and are eventually returned to full duty. In none of the cases was the foot immobilized in plaster. Ninety-nine per cent of the patients made a good recovery. A few continued to complain of pain, attributable to mental factors or to excessive callus. Non union was not observed and delayed union was extremely rare. None of the patients was discharged from the Army because of disability attributable solely to march fracture of the metatarsal. FRANK P BROOKS, M D

**Post-Traumatic Para-Articular Calcifications and Ossifications of the Ankle** Arnold D Platt Am J Roentgenol 54 348-354, October 1945

The subject of post-traumatic calcification and ossification in the soft tissues about joints is discussed in general and a case of para articular calcification occurring at the ankle joint is described in detail. Roentgenograms made shortly after a twisting injury to the ankle revealed only evidence of joint effusion. Because of pain and disability, the patient, a 22-year old soldier, was hospitalized for nine days. On return to full duty discomfort in the ankle continued. Roentgen examination about six weeks after the injury revealed a linear film-like calcification between the tibia and fibula, apparently in the interosseous membrane. A crescent-shaped calcification along the posterior malleolus of the tibia could be seen and this was not attached to the bone. Physiotherapy was begun with improvement in

symptoms, and a later roentgenogram revealed little change.

This type of lesion is best treated conservatively, with immobilization and physiotherapy. Partial disability likely to be prolonged, and full function is not regained if the calcifications persist and undergo maturity or fusion. Spontaneous regression is said to occur, but it was not observed in any of the author's cases.

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The author describes the case of a 13-year-old girl with a severe deformity of the dorsal spine and one side of the thorax. The x-ray examination revealed extensive developmental defects and lack of fusion in the 4th to 8th thoracic vertebrae, resulting in kyphoscoliosis and costal abnormalities. The bone structure and the density of the affected vertebrae were normal, and there were no signs of inflammatory or malignant change.

ERNST A SCHMIDT, M D

**Unilateral Hypoplasia of Lumbosacral Articular Processes. A Case Report.** Paul E McMaster. *J Bone & Joint Surg* 27 683-686, October 1945.

This case report deals with a 30-year-old man with pain in the lower back and right lower extremity. Physical findings indicated changes in the right hip and thigh, with measurable atrophy of the right gluteal, thigh, and calf muscles. Roentgen examination of the lumbosacral area showed the right side normal, but on the left the articular process between the fifth lumbar and the first sacral segments were markedly underdeveloped. The left lamina of the fifth lumbar vertebra was also hypoplastic. There was moderate haziness of both sacroiliac joints, indicating arthritic changes.

This report is believed to be the first to describe this particular change, although anatomical variations and anomalies are known to occur frequently in this region. Radiographically the changes are not well demonstrated in the anteroposterior and lateral views but are clearly seen in oblique views of the lumbosacral region.

JOHN B McANENY, M D

**Sagittal Cleft (Butterfly) Vertebra.** Frederick J Fischer and R E VanDemark. *J Bone & Joint Surg* 27 695-698, October 1945.

This is a report of two cases of moderate developmental abnormality of a vertebral body. One patient showed mid-line separation of two unequal portions of the third lumbar body, with the larger and higher portion on the right and the smaller and shallower portion on the left, resulting in a left lumbar scoliosis. The second patient showed a division of the body of the seventh thoracic vertebra by a narrow cleft without lateral displacement of the divided parts or anterior wedging of the body. The eighth thoracic body, however, of which the anterior third was lacking, showed marked anterior wedging resulting in a definite kyphosis at this level.

The typical butterfly appearance is demonstrable in the anteroposterior view. The adjacent intervertebral spaces may be narrowed but not collapsed.

JOHN B McANENY, M D

**Congenital Humeroradial Synostosis.** H S Murphy and C G Hanson. *J Bone & Joint Surg* 27 712-713, October 1945.

A case of bilateral humeroradial synostosis in a newborn infant is recorded. Though an hereditary tendency has been observed in other cases of this deformity, no history of its occurrence in the past three generations was obtained in the present case. References to the rather scanty literature are appended.

**Congenital Absence of the Odontoid Process. A Case Report.** Raymond C Scannell. *J Bone & Joint Surg* 27 714-715, October 1945.

Roentgen examination of a 23-year-old soldier who had sustained an injury of the neck in wrestling revealed complete absence of the odontoid process, with abnormal mobility of the atlas on the axis in flexion and extension. The previously reported cases of this anomaly, to which references are given, came under observation because of dislocation of the atlas on the axis.

**Radiologic Approaches Necessary in the Treatment of Congenital Subluxations of the Hip, from the Surgeon's Point of View.** A Laquerrière. *J de radiol et d'électrol* 26 48-51, 1944-45.

This paper is a résumé of one by Barcat published in 1943 in the *Revue d'orthopédie*. It discusses the radiologic diagnosis of congenital subluxation of the hip at three periods: before the child begins to walk, between the ages of eighteen months and eight years, and in older children.

Walking may be delayed as much as ten months after the usual time. In the youngest group three roentgen signs are of importance: (1) an exaggerated obliquity of the roof of the acetabulum (the angle with the horizon exceeding 35 degrees), (2) absence, or at least diminution in size, of the capital epiphysis, which normally appears between the sixth and twelfth months, usually about the eighth, (3) displacement outwards and upwards of the upper end of the femur, the so-called "lobster-claw" sign.

In children from a year and a half to eight years old, films of both hips are indispensable, as incipient and minimal luxations may otherwise escape notice. The clinical and radiologic signs which may occur at this age are enumerated. Arthrography following injection of a contrast medium may be useful. It is less essential in the eight- to fifteen-year-old group.

The paper is illustrated by roentgenograms. Some might take issue with the author's interpretation of one of these as "bilateral subluxation." In this, the acetabulum has a steep slope—what many American radiologists would designate as a "pre luxation stage"—but the heads are certainly not out of the acetabula.

In cases which do not easily lend themselves to closed reduction, the shelf operation is considered the procedure of choice.

PERCY J DELANO, M D

## THE GENITO-URINARY SYSTEM

**Use of the Antidiuretic Property of Pitressin in Excretory Pyelography.** Robert Lich, Jr., and Paul J Lewis. *J Urol* 54 400-402, October 1945.

The preparation of patients for intravenous urography can be reduced to a minimum by administering pitressin in doses of 0.5 c.c. (10 units) subcutaneously.

**Aseptic Necrosis of the Astragalus Following Arthrodesing Procedures of the Tarsus** Frederick M Marek and Albert J Schem J Bone & Joint Surg 27 587-594 October 1945

The blood supply of the astragalus is derived chiefly from the anterior tibial artery. Authorities differ on minor details, but there is quite common agreement that the nutrient vessels enter the bone at the neck, a rather "precarious" location. It is not surprising, therefore, that procedures involving extensive resection of the head and neck of the astragalus for the correction of foot deformities should be followed by aseptic necrosis. Mention of this complication seems, however, to be lacking in the literature, though its occurrence after fractures and fracture dislocations is well known.

The authors have encountered aseptic necrosis of the astragalus 5 times in a series of 61 cases in which wide resection of the head and neck was done. Lesser degrees of increased density and temporary mottling of the body were observed in other cases, but these changes did not persist and did not necessitate limitation of weight-bearing. The 5 case histories are presented, and roentgenograms illustrating their course are reproduced. An additional case in which necrosis developed following fracture is included for comparison.

The conclusion is reached that where extensive resection is necessary for the correction of foot deformities, it would seem advisable to remove bone from the scaphoid or cuneiform rather than from the astragalus. In any event, postoperative roentgenograms should be watched for evidence of aseptic necrosis. Should it occur, weight-bearing must be avoided for six to nine months in order to prevent collapse of the bone and eventual development of a secondary osteoarthritis of the ankle joint.

JOHN B McANENY, M D

**Metatarsal March (Fatigue) Fractures.** Albert L Leveton Am J Surg 70 49-57, October 1945

The author reports 259 cases of march fracture of the metatarsals which constituted 2.35 per cent of the orthopedic cases seen at a station hospital during a period of nine months. He considers it to be an occupational disease associated with military training and extremely rare in civilian life.

Primary importance is attached to fatigue of the peroneus longus and tibialis posticus muscles. The tendons of these muscles form a sling which assists in the support of the long plantar arch. None of the fractures occurred in association with marked degrees of pes planus and only 14 in pes planus of second degree. The atavistic foot is not believed to play an important predisposing role in these fractures, although in only 64 of the cases was there conformity to the "normal" foot, in which the five metatarsal bones are arranged in parallel formation with the head of the first metatarsal on the same transverse plane or even a little more distal than that of the second. If the second metatarsal was longer and protruded beyond the other segments, it was apt to be the site of fracture, but this did not hold true in fractures of the third metatarsal. The author does not believe that age or pre-induction occupation are contributing factors since the age distribution of his cases coincided with that of the station population in general, 53 per cent had followed a sedentary occupation, 47 per cent an active occupation. Most fractures occurred during the second to fourth month of training when the program was most strenuous.

The right foot was involved 154 times and the left 105 times. The fractures occurred in the second and third metatarsals 228 times. Twenty three cases of multiple fractures were found and in 10 of these the fractures were bilateral. The second and third metatarsals again were most frequently involved. The fracture was complete in 199 cases and incomplete in 60 cases. In 35 there was some displacement.

The onset of clinical symptoms usually followed a long or forced march and was acute or insidious. The patient was usually able to continue with his march, and the average interval between the onset of symptoms and hospitalization was 15.4 days. Pain and swelling of the dorsum of the foot were the usual complaints. Physical examination showed point tenderness and swelling over the involved metatarsal. Motion of the toe caused pain.

The roentgen findings vary with the age of the injury, and a negative roentgenogram is not conclusive in the presence of positive clinical findings. In some cases the author advises a recheck in about a week. Early in the first week there may be merely periosteal elevation and thickening. Following the first week there may be diffuse thickening of the periosteum. More commonly the fracture extends through the entire thickness of the bone. Large, fluffy, or cottony callus at the fracture site is one of the characteristics of metatarsal march fracture, but there is slight production of callus in fractures involving the neck. When a fracture involves the first metatarsal, it occurs at the base and is of the "ice-crack" type. After four to six weeks the callus becomes organized and a fusiform swelling is present at the fracture site. Angulation is not common.

The patients are kept at bed rest for three weeks although no untoward effects were observed in a small group who were permitted to bear weight on the heel after seven to ten days. They are then placed on a reconditioning program for two to four weeks, and are eventually returned to full duty. In none of the cases was the foot immobilized in plaster. Ninety nine per cent of the patients made a good recovery. A few continued to complain of pain, attributable to mental factors or to excessive callus. Non-union was not observed and delayed union was extremely rare. None of the patients was discharged from the Army because of disability attributable solely to march fracture of the metatarsal.

FRANK P BROOKS, M D

**Post-Traumatic Para-Articular Calcifications and Ossifications of the Ankle** Arnold D Piatt Am J Roentgenol 54 348-354, October 1945

The subject of post-traumatic calcification and ossification in the soft tissues about joints is discussed in general and a case of para articular calcification occurring at the ankle joint is described in detail. Roentgenograms made shortly after a twisting injury to the ankle revealed only evidence of joint effusion. Because of pain and disability, the patient, a 22 year old soldier, was hospitalized for nine days. On return to full duty, discomfort in the ankle continued. Roentgen examination about six weeks after the injury revealed a linear film-like calcification between the tibia and fibula, apparently in the interosseous membrane. A crescent shaped calcification along the posterior malleolus of the tibia could be seen, and this was not attached to the bone. Physiotherapy was begun with improvement in

pancreas 1, colon 1) All of the patients were bad risks for any operative procedure and would have died within a few months at most if untreated. At the time of the report 5 were doing well at over eighteen, fifteen, fifteen, seven, and five months after combined operation and irradiation.

Although the series is small, the authors believe the results show that their method is a rational and hopeful advance in the treatment of inoperable cancer of the viscera. While wider exposure is needed than for surgery alone, the whole procedure, with adequate precautions, should be less shock-producing than wide surgical excision.

Having no precedent to indicate the effects of high tumor doses within a minimum of 2-5 min, rather smaller doses than could be expected to be curative alone were given to the earlier cases, and supplementary external irradiation was started ten days following operation. At first only one x-ray tube (a Metropolitan Vickers constantly evacuated tube of the 250 kv type) was used, now two tubes are employed simultaneously in treating a single lesion. This has been done to increase the lesion intensity to double that available with the standard apparatus. The lower tube has a vertical traverse only, whereas the overhead tube has a vertical and horizontal traverse. With the single tube, the total initial lesion dose through the wound has been 500-1,200 r, the latter figure being chosen in the earlier cases because it had proved effective in certain superficial lesions. With the two tubes, a provisional figure of 1,300 r was decided on as a minimal dose throughout the tumor, entailing a surface dose of 1,350 r from each tube simultaneously. Even after a dose of 1,500 r in about three minutes there was remarkably little reaction. Such reaction as did occur came on later, when the operative shock had passed off, and was limited to slight nausea and anorexia, with rare vomiting. The radiation reaction was more severe and the recovery much slower in the patients who received external irradiation.

**Qualitative and Quantitative Histological Examination of Biopsy Material from Patients Treated by Radiation for Carcinoma of the Cervix Uteri.** A Glücksmann and F G Spear. *Brit J Radiol* 18 313-322, October 1945.

Glücksmann in 1941 described a method of evaluating quantitatively the results of radiation on human malignant tissue by serial biopsies during treatment (*Brit J Radiol* 14 187, 1941. *Abst in Radiology* 38 125, 1942). This makes possible an earlier prognosis in individual cases and more rapid evaluation of methods of irradiation than waiting for the customary three- and five-year periods. This method was applied to 166 patients with carcinoma of the cervix treated since 1938 by some modification of the Stockholm technique. A further series of 502 cases treated between 1930 and 1939 was classified on the basis of a pre-irradiation biopsy, according to the degree of anaplasia and the cells were compared with the clinical follow up, which covered at least five years.

The method consists in classifying the entire cell population of selected young areas from the primary and in serial biopsies done before, during and after treatment. It is important to select young areas from the growing edge. The cells are placed in four categories: dividing, degenerating, resting, and differentiat-

ing. By plotting these counts as percentages against time on a graph, curves are obtained which indicate the effectiveness of the irradiation.

Many biopsies were made in the original studies. In practice, it was found that four, at 0 (pre-irradiation), 7, 14, and 28 days after the first irradiation, were sufficient for a reliable assessment of the histologic response.

An unfavorable response is characterized by a persistence of mitosis, little or no alteration in the resting and degenerating cells, and no increase in the number of differentiating cells. A favorable response is indicated by an early disappearance of mitosis, a later disappearance of resting cells, and an increase in the degenerating and differentiating cells. Eventually there is a fall in the differentiating cell count corresponding to an increase in the degenerating cell count.

In the majority of cases there is agreement between the histological and the clinical observations. The main cause of disagreement, which appears in the early months after treatment, is the absence of clinically recognizable cancer when there is evidence histologically of malignant growth. During this period, apparent healing does not necessarily mean absence of malignant cells. The percentage of disagreement between histological prediction and clinical observation decreases with the passage of time.

In this series, on the basis of the pre-treatment biopsies, the tumors were classified as "anaplastic parakeratotic," showing practically no signs of differentiation, "anaplastic squamous," with cells resembling young normal basal cells, and "anaplastic columnar," showing adenocarcinomatous characteristics. The anaplastic parakeratotic tumors show a less satisfactory response than tumors of the other two groups in the same stages, but this is not uniformly consistent, indicating that other factors than histologic classification play a part.

Other factors which may influence the outcome may be uncontrollable variations in the distribution of the radiation in spite of every effort to keep it standardized. There may be unrecognized tumor cells outside of the area irradiated, or distant metastases, or unfavorable factors in the surrounding tissues.

The survey of the 502 cases which have a five-year follow up confirms the fact that irradiation is less satisfactory in anaplastic tumors than in differentiating types.

SYDNEY J. HAWLEY, M.D.

**Carcinoma of the Female Urethra (Review of the Literature and Report of Three Cases)** S G Clayton. *J Obst & Gynaec Brit Emp* 52 508-512, October 1945.

Three cases of carcinoma of the urethra in women are reported. One patient remained well for two years following excision of the cancer and implantation of radon seeds, but was then lost trace of. Excision of the tumor and implantation of radon seeds was carried out in the second woman, aged 70, but in view of her age and condition, inguinal dissection was not performed. She remained well for three years, at the end of which time a local recurrence appeared. She was treated with x rays and implantation of radon seeds, with no evidence of recurrence at the date of the report (four years after the operation). The third patient, aged 82, was gravely ill on admission to the hospital. The bladder was distended up to the umbilicus and attempts to pass a catheter failed because the distal urethra was surrounded by a submucous induration, which extended

twenty minutes before the intravenous injection of the contrast medium. The patients are denied neither food nor drink. A satisfactory concentration of urine results, due to the reabsorption of water in the renal tubules. The absence of undesirable reactions is attributed to the small dose and the fact that the patients are not starved and not dehydrated. Pregnancy is a contraindication.  
J L BOYER, M D

**Unilateral Triplication of the Ureter and Renal Pelvis**  
John T MacLean and E W Harding J Urol 54 381-384, October 1945

Only three authentic cases of unilateral triplication of the ureter and renal pelvis are on record. A double or triple ureter results from the development of more than one ureteric bud from the wolffian duct. In the case reported here, two of the ureters fused just prior to entrance into the bladder. It is probable that the third ureter arose as an outpouching of the second ureteric bud. The patient was a man of 41, complaining of pain in the left lumbar region after an attack of pneumonia. Intravenous and retrograde pyelography revealed the developmental anomaly.  
ALTON S HANSEN, M D

**Congenital Valve in the Upper Ureter** John T MacLean J Urol 54 374-380, October 1945

Ureteral valves of congenital origin at the sites of normal ureteral narrowing are said to be present in 20 per cent of all persons. Valves in the upper ureter, however, are extremely rare. The author mentions Eisendrath, Hunner, Gottlieb, and Campbell as having reported cases of upper ureteral valves, and he himself presents a case. The valve was in the right ureter at the junction of the middle and upper thirds. The patient gave a childhood history of enuresis, but except for this had experienced no urinary symptoms until he was twenty-six years old. At that time frequency, dysuria, and pain developed. The roentgen findings were those of hydronephrosis, with apparent obstruction at the ureteropelvic junction and dilatation of the upper end of the right ureter. The valve was removed surgically and the patient, a sailor, returned to active sea duty two and a half months after operation with definite improvement, though not complete disappearance, of the hydronephrosis. Preoperative and postoperative pyelograms and ureterograms are reproduced.

JAMES C KATTERJOHN, M D

## RADIOTHERAPY

### NEOPLASMS

**Transitional Epithelial Cell Carcinoma of the Nasopharynx** J E Whitelkather Am J Roentgenol 54 357-369, October 1945

Sixteen cases of transitional epithelial-cell carcinoma of the nasopharynx observed and treated during the five-year period between 1937 and 1942 form the basis of this report. This type of tumor has been the most common one in this location in the author's experience. A review of the literature on the historical aspects and the pathology of the lesion is given. Clinically, diagnosis often is difficult even when the disease has reached an advanced stage. Direct visualization of the tumor may require repeated nasopharyngeal examinations. Lateral and mentovertebral roentgenograms of the nasopharynx may be helpful in showing luminal defects on the posterior and lateral walls. Symptoms are extremely variable and include deafness, double vision, "sinus aches," and the like. A unilateral compression of the eustachian tube occurred early in the disease in 12 cases. This is usually a minor symptom and is manifested as a clicking sound or a roaring in the ear. Cervical adenopathy was the next most common finding. Cranial nerve involvement was present in 9 cases, the fifth nerve being most frequently affected.

In treatment radiation therapy is the method of choice, as adequate surgery is impossible. The method of treatment is outlined in detail.

L W PAUL, M D

**Adamantinomas of the Jaw, with Reference Especially to Their Treatment.** Karen Lübschutz Acta radiol 26 441-455, Aug 31, 1945 (In English)

A review is given of the history, location, morphology, and histologic appearance of adamantinomas, and the etiologic relationship between that tumor and the enamel organ is discussed. Adamantinomas are, as a rule, considered benign, although malignant examples have been recorded.

Eleven adamantinomas were seen at the Radium Center in Copenhagen in the years 1932-43, the diagnosis being established by roentgen examination and biopsy. Seven of the tumors were in the upper jaw and 4 in the lower. This distribution differs from that usually found, but is explained on the basis of the small number of cases. In the mandible, the roentgenographic picture shows a well defined area of rarefaction or several such areas more or less confluent. In the maxilla, the picture is less characteristic. The only early sign may be the haziness of the maxillary sinuses, and not until later do signs of bone destruction appear. Biopsy is necessary for a definite diagnosis.

The treatment of the cases reported here was partly surgical and partly roentgenological, but the author stresses the fact that surgery is the only effective method of therapy. The most efficacious surgical method is complete resection of the portion of the bone in which the tumor is present, for though these tumors are histologically benign, they may be clinically malignant. Occasionally, a well circumscribed solid tumor may be enucleated. Radiation therapy has practically no effect and should be used only as a palliative measure in far advanced cases.

J H WEISS, M D

**Direct Irradiation of Cancer of the Stomach and Other Viscera Exposed Temporarily at Operation.** G Cranston Farchild and Alan Shorter Lancet 2 522-526, Oct 27 1945

Because of the failures of surgery, external irradiation, radon seed implantation, and intracavitary irradiation in gastric cancer, the authors have devised a method of combined surgery and direct irradiation. During the past eighteen months they have used this procedure in 15 cases of inoperable visceral cancer. In 6 of these cases (cancer of the stomach 3, esophagus 2, colon 1), the lesion had spread beyond the possible field of irradiation and little beneficial effect was achieved. Details and results of treatment are given in the other 9 cases (cancer of the stomach 6, abdominal esophagus 1).



**Indications and Statistics on the Radiation Treatment of Utero-Adnexal Tuberculosis and of Tuberculous Peritonitis with Genital Lesions** R Mathey-Cornat J de radiol et d'électrol 26 52-55, 1944-45

The author reports a series of 160 cases of peritoneal and genital tuberculosis in the female, about half of which were treated by actinotherapy and heliotherapy, while the other half were given radiotherapy. He discusses the treatment in relation to the relative advancement of the peritoneal process, degree of visceral involvement, age of the patient, and response to medical and surgical measures. The classification on these bases is rather elaborate and none too clear, and several points as to the general management of patients with peritoneal tuberculosis may be called into question.

For one thing, in patients not making satisfactory progress, and in whom the diagnosis of salpingitis or oöphoritis of tuberculous origin has been established, roentgen sterilization is advocated. Actually the rationale of this procedure is not understood, and its benefits may be questioned.

A rather large group, not too advanced, are selected for actinotherapy, this has always had a vogue, but its merit, *per se*, has not been established. Certain procedures have always been conceded an empiric status in the treatment of tuberculous peritonitis, sun-ray exposure is one of them, and surgical opening of the abdomen is another. The real fact of the matter is, and is now understood to be, that tuberculous peritonitis, unless complicated by the involvement of some viscera which establish their own obstacles to cure, is a relatively benign condition which in the great majority of instances goes on to recovery, rest is the prime essential in treatment and is aided by all measures that fortify the patient's resistance. The value of exploratory laparotomy is questioned by most authorities, as is the value of any form of radiant energy. Certainly, in those cases which are progressing satisfactorily after removal of one tube or ovary, roentgen exposure should not be considered, any value which might accrue from its use would not serve to compensate for the sterilization which must accompany the treatment.

It is noteworthy here that the author states that the more severe the peritoneal process, the lighter should be the x-ray exposure. PERCY J DELANO, M D

**Ankylosing Spondylitis Symposium** H Wyatt, R McWhurter, and Hernaman Johnson Brit J Radiol 18 301-308, October 1945

Following some introductory remarks by Wyatt, McWhurter presents a general discussion of ankylosing spondylitis of the Marie-Strümpell type. Clinical and radiological descriptions usually refer to advanced disease. Since, however, little or nothing can be done in the late stages, the early recognition and treatment are all important. The onset is usually in the third decade and males are predominantly affected. In a series of 168 cases 91 per cent were males, and their average age at onset was twenty six years. The cause is unknown. The rate of development varies from a few months to many years.

The first symptoms consist of flitting pains in the back and hips, gradually becoming more constant and localizing in the lumbar region. On flexion the erector spinal muscles stand out prominently. There is tenderness over the sacroiliac joints and sometimes along the crests of the ilia. Chest expansion is restricted. The

patient looks toxic, and the sedimentation rate is raised.

The first x-ray findings are blurring and irregular destruction of the sacroiliac joints with sclerosis of the adjacent bone. The spine at this stage may show no abnormalities. Only later is the "bamboo" spine demonstrable, with fixation of the hip and shoulder joints. As the disease advances, the posterior articulations of the spine are narrowed and indistinct and the margins of the vertebral bodies become sharp. Still later the anterior and lateral ligaments are ossified.

The first stage in the treatment is x-ray therapy. Treatment is given over the sacroiliac joints and the entire spine. A total of 2,500 r (whether in air or with back-scatter is not specified) generated at 250 kv, with 1 mm steel filter, is given in divided daily doses within two weeks. Irradiation relieves the pain and stiffness, but prolonged orthopedic treatment is an essential part of the management. The relief of pain produced by irradiation makes possible more effective exercise and massage.

Hernaman Johnson discusses the prognosis of spondylitis in relation to treatment. As regards capacity to earn a living he finds the prognosis good. One paragraph from his paper may be quoted in full.

"Let us suppose then, that by some form of x-ray treatment we have made a patient symptom-free. What are his chances of so remaining? In early cases, when there is no loss of mobility but only pain, and where there are only slight radiographic changes confined to the sacroiliac joints, the prospects of a long remission extending into years are good. I have had one patient under observation for fourteen years, with no sign of relapse. Several young men treated in the years immediately preceding the war have since joined the Services. Some have been invalidated, others remain fit for duty. A common experience at the Charterhouse Clinic is for a man to turn up after four or five years, stating that he has been quite well during all this time but has lately had a return of pain. He believes that 'a few treatments will put him right.' One looks up his record, and finds that, let us say, his pain had all disappeared within three months under x-ray treatment, and had, indeed, mostly gone in a matter of weeks. The patient is full of confidence, he expects this miracle to be repeated, and sometimes it is. But by no means always. His blood should be examined and any anemia combated. Then, the previous treatment may be tried, but if it does not seem to be effective, no good can come from pushing it." SYDNEY J HAWLEY, M D

**Eosinophilic Granuloma of Bone** Paul Michael and Nathan C Norcross U S Nav M Bull 45 661-668, October 1945

The cause of eosinophilic granuloma of bone is still in question but its incidence is higher than previously suspected. The authors describe it as a benign destructive lesion affecting principally the skeletal system, with a predilection for the ribs and skull [to which he might have added the pelvis]. It is no longer considered a solitary lesion but rather frequently affects multiple osseous areas. The histologic picture is unusual, revealing large accumulations of histiocytes, eosinophilic cells, leukocytes, and giant cells. These last are probably of two types, phagocytizing and osteoclastic. Roentgenograms are suggestive but not diagnostic. The interior of the bone is primarily involved, while the cortex is expanded and frequently eroded. The

beneath the intact vaginal epithelium. Suprapubic drainage was established and a part of the growth was excised for section. Fifty milligrams of radium in a flat container with filtration equivalent to 3 mm of lead was applied to the anterior vaginal wall and vestibule for forty-eight hours on two occasions. The growth retrogressed so that a catheter could be passed, but the patient's general condition failed to improve and she died a month later.

The literature is reviewed briefly.

**Some Remarks on Giant-Cell Tumors and Their Treatment by Radiotherapy Considered Over a Long Period.** F. Baclesse. *J. de radiol. et d'électrol.* 26:41-46, 1944-45.

The author begins with the general statement that giant-cell tumors are in the benign group but show a marked tendency to growth when partially destroyed by either surgery or radiation. If treated by surgery, they should be completely extirpated, though this sometimes necessitates amputation or disarticulation, if radiation therapy is used, the dosage should be adequate.

One term used by the author impressed the abstractor as original and descriptive, namely, *pousse oséolytique*, or "osteolytic thrust." By this is meant growth of the tumor by a peripheral advance of osteolysis, followed by a period of recalcification, so that a zone of osteolysis may be rimmed by a zone of increased density, or the two processes may appear successively. This phenomenon of osteolysis followed by calcification may take place three or four times in a period of eight or ten or twelve years, producing an effect described as an "accordion like tumor," which is shown in the illustrations accompanying the text.

Attention is called to the impression of sarcomatous degeneration sometimes gained on viewing a film made during an osteolytic episode, radiotherapy vigorously undertaken at such a time may soon rule out sarcoma by initiating the calcific phase.

Successive films of two cases are reproduced, a tumor of the lower end of the radius and one of the upper end of the humerus. Both tumors were large and were followed over long periods; the end-results in each were declared good from the functional standpoint, a firm zone of calcification enclosing the tumor in each instance.

Twenty cases irradiated over a period extending from 1920 to 1933 are reviewed.

The caution is given that the rate of growth of the tumor, as well as its tendency to osteolytic episodes, must be observed and taken into consideration, so that if it appears that operation will ultimately be inevitable, too much skin damage may not have been sustained in the surgical field.

PERC J. DELANO, M.D.

**An Unusual Case of Hodgkin's Disease. Second Report.** John W. Avery and J. W. Warren. *Arch. Ophth.* 34:318, October 1945.

In 1941 (*Arch. Ophth.* 26:1019, 1941), the authors presented a case of Hodgkin's disease involving the lymphatics of the bulbar conjunctiva of both globes, as well as various lymph nodes elsewhere in the body. In May and June 1940, the patient was given fifteen roentgen treatments to the eyes, the left cheek, the two sides of the neck, and the groins (a total of 3,000 r, of which 1,400 r was directed to the eyes). In November

and December of the same year, a second series of ten treatments (2,000 r) was given, distributed as before except that none was given to the eyes. Ten days after the first roentgen treatment the ocular lymphoid growths were thinner and somewhat bleached. Improvement was general and constant. On Nov. 12, 1941, the globes were entirely free from lymphoid tissue, the sclerae being white. The vision was normal.

In the present report, the authors bring the case up-to-date. In 1942 no treatments were given. In May and June 1943, ten roentgen treatments were given to the somatic nodes only (amount not stated). There has never been the slightest tendency to a recurrence of the lymphatic involvement of the bulbar conjunctivae. The eyes seem clear. There is still a small residual lump in the left cheek, but no palpable enlargement of the superficial lymph nodes in the groins, axillae, and c-bowes. The spleen does not appear to be enlarged.

### NON-NEOPLASTIC DISEASE

**Monel Metal Radium Applicator Designed for Maximum Use of Hard Beta Rays in the Treatment of Nasopharyngeal Hyperplastic Lymphoid Tissue.** Curtis F. Burnam and Samuel J. Crowe. *Mississippi Valley M. J.* 67:109-111, October 1945.

**Radium Treatment of Hyperplastic Lymphoid Tissue in the Nasopharynx.** Gilbert E. Fisher. *Ibid.* pp. 112-115.

**Radium Therapy in Benign Nasopharyngeal Pathology (Use of the Radium Applicator Devised by Burnam and Crowe).** Harold Swanberg. *Ibid.* pp. 118-119.

The three papers listed above are devoted to the radium therapy of benign nasopharyngeal lesions by means of a new applicator designed by Burnam and Crowe. The essential feature of the applicator is a monel metal chamber, 15 mm. long, with an inside diameter of 17 mm. and a wall thickness of 0.3 mm., attached to a semi-flexible handle. The chamber holds 50 mg. of radium and the thin wall of the capsule allows the emission of a sufficient volume of beta rays so that treatment can be given rapidly—eight and a half minutes per area irradiated. As a rule, three applications at twenty-five-day intervals are adequate for the treatment of hyperplastic lymphoid tissue, but four or five may sometimes be required. The method is easy and painless (no anesthetic is required), it is without ill effects and entails no loss of time from the patient's work.

Fisher reports good results in deafness, particularly in children, associated with malfunction of the eustachian tubes; recurrent acute upper respiratory infections especially those beginning with irritation in the nasopharyngeal lymphoid tissue, recurring attacks of otitis media, bronchial asthma, particularly in children; aero-otitis, selected cases of tinnitus and vertigo, and chronic obstruction of the posterior nares in children. His failures (about 11 per cent) he attributes to an insufficient number of treatments.

To the advantages mentioned above, Swanberg adds the economy of the method, giving details as to the rental cost of radium and rental and purchase cost of the applicator. He appends a comprehensive bibliography. The remainder of this issue of the *Mississippi Valley Medical Journal* is made up of abstracts of papers published elsewhere dealing chiefly with the use of radium in otolaryngologic practice.

strict capillaries and to make them impermeable, while potassium ions have the opposite effect.

Lymphatic and venous obstruction, when sufficiently great to produce asphyxial damage to the capillary walls, may produce edema. Infection may exercise an influence through its action on the circulation and from substances liberated in the infected area. Certain structural peculiarities of the neck in relationship to the vessels and the connective tissues predispose to the production of edema in this region.

It can be assumed that when a large amount of cellular material, inflammatory or neoplastic, is being broken down, sufficient changes in the pH occur to be a significant factor. Decreased extravascular pressure may play a role in localized edema.

Edema of the glottis is really a misnomer. Studies by injection of fluids in calves indicate that edema will first occur in the aryepiglottic fold, next in the glossopylloic fold, then the anterior surface of the epiglottis and the vallecula. The character and attachments of the connective tissues influence the distribution of the fluid. The reaction of the connective tissue is most probably alkaline under normal conditions. Acid causes swelling of the connective-tissue fibers and alkali produces swelling of the ground substance. The more acid or alkali that is added, the more water is attracted up to a certain maximum.

Under irradiation, capillary dilatation occurs from direct effect on the endothelium and indirectly from the production of dilator H substances. The arteries become constricted, decreasing the blood supply to the capillary endothelium. Slight swelling of the sub-endothelium contributes to the narrowing of the vascular lumen. An inflammatory reaction sets in, with diapedesis of leukocytes, and fibrin clusters form around the vessel walls.

The reversible changes which lead to edema sooner or later become irreversible. When lymphatic drainage is blocked, the amount of tissue fluid rises. This is intensified when infection, inflammation, and venous obstructions supervene. The tissue fluid becomes clotted, encasing cells in various stages of disintegration.

This material serves as a substrate comparable to that used in tissue cultures. This favors the growth of fibroblasts, which may encase viable tumor cells. Therefore, edema should be avoided if possible.

Gross edema is readily recognized, but beginning edema may present great difficulty. Early changes may be recognized by sagging of fluid in the nooks and crannies of the pharyngolaryngeal region, slight prominence of the aryepiglottic folds or the ventricular bands, blurring of the details in or around the growth, some degree of asymmetry between the two halves of the larynx, pain and immobility without or with fixation. Sometimes the evidences of early edema may be identified by soft-tissue radiography.

No single remedy can counteract all the various causes of edema. A mixed diet of adequate protein content is essential. Histamine and vitamin C should be tried. Foci of infection should be cleared up. Alkaline gargles are advantageous. Calcium gluconate, 10 per cent, may be given intravenously. The prevention of pain is of great importance. This may be accomplished by sprays of urethane, 1.6 in water with 1 per cent ephedrine and 1 per cent cocaine with a few drops of peppermint. SYDNEY J. HAWLEY, M.D.

#### Spontaneous Bilateral Fracture of the Neck of the Femur Following Irradiation. Clarence H. Heyman, J. Bone & Joint Surg. 27: 674-678, October 1945.

A 60-year old woman who was irradiated by x-rays and radium, for carcinoma of the cervix, complained of pain in the right hip fourteen months after completion of the treatment, but no abnormality was demonstrable radiographically. Eleven weeks later a roentgenogram showed a fracture in the right femoral neck, which was fixed with a Smith-Petersen nail. Three months later pain developed in the left hip and a fracture of the left femoral neck was found. This fracture was also nailed. The treatment proved effective in both instances and it is suggested as the procedure of choice in irradiation fracture of the femoral neck.

JOHN B. McANENY, M.D.

## EXPERIMENTAL STUDIES

**Hereditary Achondroplasia in the Rabbit. I. Physical Appearance and General Features.** Wade H. Brown and Louise Pearce. **II. Pathologic Aspects.** Louise Pearce and Wade H. Brown. **III. Genetic Aspects, General Considerations.** Louise Pearce and Wade H. Brown. J. Exper. Med. 82: 241-295, Oct. 1, 1945.

Hereditary achondroplasia in rabbits characterized by size reduction and by a disproportion of bodily parts most marked in the extremities, is described. The disease is incompatible with life. Only 11 of the 228 animals with the disease were alive when the litter was first examined, a few hours after birth. 5 of these survived only a few minutes, and 4 for six hours, while 2 are known to have lived at least twelve hours. The variation arose in pure bred Havana stock. The abnormality is determined by the expression of a simple recessive unit factor, affected individuals being homozygous for the factor. Females are somewhat more frequently affected than males, but the character is not

sex-linked. Rabbits heterozygous for the factor as determined by appropriate breeding tests have a perfectly normal appearance at birth and in later life.

In physical appearance and in the character of the skeletal changes, as shown by roentgenography, achondroplasia in the rabbit has a remarkable resemblance to the disease in man and in cattle and dogs.

**Investigation into the Time Factor in the Roentgen Irradiation of Cancer Cells. Protraction Experiments with a Transplantable Mouse Round-Cell Sarcoma and a Transplantable Mouse Carcinoma.** B. Refslund Poulsen. Acta radiol. 26: 463-483, Aug. 31, 1945. (In English.)

The purpose of the research done by the author was to investigate the time factor in the radiation of cancer cells. Since protraction offered the best experimental conditions its effects were examined on two transplantable mouse tumors. One was a rapidly growing, sensitive, round cell sarcoma, the other was a slowly

condition is practically limited to children and young adults, especially males

Surgical treatment is most desirable, as biopsy proof of the disease is achieved at the time the lesion is removed. X-ray therapy is also beneficial. Spontaneous healing is known to occur. There may be a relatively long interval between the recognition and treatment of the initial lesion and the appearance of subsequent lesions.

The authors present two cases with fairly good photomicrographs. In one patient, a 25-year-old man, the lesion, measuring  $1.8 \times 1.2$  cm., involved the right temporal region. Excision was sufficient therapy. The second case was in a 21-year-old man, and the site was the region of the 8th and 10th thoracic vertebrae, with production of a transverse myelitis. After biopsy, 2,242 r (no other factors given) were given to the area, three months later neurologic symptoms had largely disappeared and the patient was able to walk without difficulty.

SYDNEY F. THOMAS, M.D.

## TECHNIC

**The Chaoul Method and Classical Superficial Radiotherapy. A Study of Absorption Curves.** Jean Calvet and P. Marquès. *J. de radiol. et d'électrol.* 26: 20-22, 1944-45.

The tube utilized in the Chaoul technique follows essentially the lines of Coolidge tube construction, with a filtration equivalent to 0.2 mm of nickel, the kilovoltage is about 60, and the milliamperage about 3. A table shows the coefficients of transmission in water in percentage of the incident dose and includes similar observations for five other tubes. These coefficients are also presented in the form of plotted curves.

Chaoul radiation at 60 kv is slightly harder than the so-called classical soft radiation at 100 kv, unfiltered. The real advantage of the Chaoul tube is in the inclined anode, rather than in the physical qualities of the radiation emitted. Particularly is this anode of advantage in intra cavity work.

PERCY J. DELANO, J.D.

## RADIATION EFFECTS

**Radiation Hazards in Medical Practice.** D. B. Harding. *Kentucky M. J.* 43: 228-231, September 1945.

This article is directed to those physicians who use x-ray and radium occasionally, who are apt to be less cognizant of the dangers inherent in the use of these modalities than are radiologists. A brief history of the development of x-rays and the experiences of the early pioneers with their frequently tragic results is given. The more recent improvements in equipment are noted, such as shock-proofing and lead protection of apparatus, so that the radiation is considerably more controlled than it previously was, but it is pointed out that this does not protect from over exposure.

The author urges the use of as small a field as possible in fluoroscopic work and moving the patient about so that no particular part of the skin is over-exposed. He also emphasizes the need for keeping the hands of the operator out of the direct beam of radiation even though protecting gloves are worn. He warns against habitually calling upon some one person about the office to hold patients during radiography. He states that with the normal use of a radiographic machine in a general practitioner's office, lead protection is not usually necessary. If the operator will be careful to stand at a reasonable distance from the machine and never direct radiation at himself, he will not receive a sufficient amount of scattered radiation to do any harm.

The use of radium by the more or less uninitiated is still more dangerous than the use of x-rays, since the gamma rays of radium are so much more penetrating. Recommendations are made for the storage of radium and for the construction of a special table for the handling of radium applicators. The two most serious dangers are the danger of radium burn to the hands from the handling of applicators and the danger of production of anemia or leukemia. March's figures (*Radiology* 43: 275, 1944), are quoted, indicating that leukemia is ten times as common among radiological physicians as among non-radiological physicians.

In conclusion, the author discusses the use of anesthetics and quotes Lundy's recommendation that only nitrous oxide and oxygen be used as volatile anesthetics

in the fluoroscopic room. He further recommends that a combination of avertin or intravenous anesthesia and nitrous oxide and oxygen is the most desirable method. He warns against the use of ether, cyclopropane, or ethyl chloride in the fluoroscopic room as exceedingly dangerous.

BERNARD S. KALAJIAN, M.D.

**X-Ray Burns Resulting from Fluoroscopy of Gastro-Intestinal Tract.** L. H. Garland. *J. A. M. A.* 129: 419-421, Oct. 6, 1945.

The particular hazards associated with the use of the small portable x-ray unit when it is employed for fluoroscopy are emphasized in this article. During fluoroscopic examination of the gastro-intestinal tracts of four patients on the same day by a physician who was not a specialist, all of the patients received serious x-ray burns over their backs. The skin and underlying soft tissues in the affected areas were permanently damaged.

The author points out that if three factors, adequate distance, reasonable voltage, and low milliamperage are borne in mind, the average fluoroscopist doing gastro-intestinal work is not likely to cause serious damage. The advisability of proper speed or dispatch in examination is also pointed out.

JOHN F. HOLT, M.D.  
(University of Michigan)

**Causes and Prevention of Radiotherapeutic Edema of the Larynx.** Benjamin Jolles. *Brit. J. Radiol.* 18: 278-283, September 1945.

The factors upsetting the normal equilibrium between the tissue spaces and the blood stream are manifold. Normally the capillaries act as semipermeable membranes. Dilatation of the capillaries may bring about increased permeability, and this may be sufficient to cause edema. Histamine and histamine-like substances also affect capillary permeability. A lowered plasma protein level in the blood or an increased protein content in the extracapillary spaces may affect the fluid balance.

A change in the sodium, calcium, and potassium ratio produces alterations in the water and salt exchange between the blood and tissue spaces. Calcium tends to

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## External Therapeutic Use of Radioactive Phosphorus

### I Erythema Studies<sup>1</sup>

BERTRAM V. A. LOW BEER, M.D.

San Francisco, Calif

THE PHYSICAL properties of radioactive phosphorus ( $P^{32}$ ) make it suitable for studying the effect of beta particle radiation on the skin. Radioactive phosphorus emits beta particles only and disintegrates at a daily rate of 4.8 per cent, thus losing one half of its initial activity in 14.3 days. The beta particles of radioactive phosphorus have a continuous energy spectrum ranging from 0 electron volts (e.v.) to  $1.69 \times 10^6$  e.v. The average energy of the radioactive phosphorus particles is approximately  $70 \times 10^5$  e.v. The greatest abundance of the particles occurs at the average energy. Approximately 600 cm is the maximum distance a beta particle of radioactive phosphorus can travel in dry air at  $0^\circ C$  temperature and 760 mm Hg pressure, in water or tissue the maximum distance is approximately 8 mm (1-4).

### TECHNIC

The radioactive phosphorus used in the study to be reported here was an aqueous solution of disodium hydrogen phosphate containing 15 mg of the salt per cubic centimeter of water. The radioactivity of the solution was measured at the Radiation Laboratory of the University of California in Berkeley and determined in microcuries per cubic centimeter. The figures re-

ported here refer to activity measurements determined by the method and standards used at that laboratory. Discrepancies were found in the activity of radioactive phosphorus when measurements were made at different centers. Thus, when a solution is used, the activity of which has been determined at the Washington University laboratories in St. Louis, it is necessary to apply a correction factor of +1.1, while for activities determined at the Massachusetts Institute of Technology a factor of -2.3 must be employed at the present time to obtain comparable figures (5).

Early in these studies the need became apparent for a technic by which the exposures and reactions could be exactly reproduced. After prolonged trial of numerous vehicles, such as absorbent cotton, lanolin, vaseline, gum acacia, etc., it was found that ordinary thin blotting paper is a most suitable and simple vehicle for the radioactive phosphorus solution. Blotting paper of known dimensions soaked in measured amounts of  $Na_2HPO_4$  solution and dried can be applied easily in contact with any part of the skin, and exposures can be reproduced exactly. Disks of blotting paper 2.5 cm in diameter (4.9 sq cm in area) and 0.4 mm in thickness (21 mg/cm<sup>2</sup>) were used in these experiments. The disks were applied over normal healthy skin on the flexor surfaces of

<sup>1</sup> Accepted for publication in June 1946

growing, resistant carcinoma (Krebs No 2) Preliminary experiments established the statistical reliability of the new experimental method which was employed

The protraction experiments were carried out with a so-called middle dose This dose was found to be 1,160 r for the round cell sarcoma and 1,600 r for carcinoma, at 175 kv, with filtration of 0.5 mm Cu + 1.0 mm Al The tumors were irradiated at intensities of 58, 12.3, 3.3, and 1 r per minute In the case of carcinoma, a steadily decreasing effect was found with increasing protraction The percentage of takes fell about 20 per cent when the intensity was varied from 58 r to 1 r per minute It was also found that the latent period was decreased when transplantation was made twenty four hours after irradiation, as compared with immediate transplantation

The round cell sarcoma showed no essential change in effect when the intensity was varied from 58 r to 3.3 r per minute, but at 1 r per minute there was a definitely increased effect Whereas the percentage of takes with the higher intensities varied from 43 to 48 per cent (when transplantation was done twenty-eight hours after irradiation had begun), it was only 5 per cent with an intensity of 1 r per minute In other experiments, the percentage of takes at the two extremes differed by at least 25 per cent A longer latent period was also produced

Histologic changes in both tumors following irradiation are also described

While the results show a definitely increased radiation effect in round-cell sarcoma with protraction, the author feels that the effect would probably again be decreased at a still lower intensity and believes that a critical intensity has been demonstrated In the case of carcinoma, the decreasing effect with increased protraction is explained as an incomplete cumulation as a result of regeneration during irradiation Two theories are advanced for the explanation of the critical intensity, one assumes a sensitive phase in the cell cycle, the other that irradiation produces an increased cell sensitivity

J H WEISS, M D

**X-Ray Diffraction Studies on Fish Bones** George C Henny and Mona Spiegel-Adolf *Am J Physiol* 144 632-636, Sept 1, 1945

For x-ray diffraction studies of bones the authors have found those of fish particularly well adapted

They report such a study, including a comparison with mammalian bones

**Eggs of the Bombyx-Mori as Material for Radiobiological Research** J P Lamarque and C Gros *Brit J Radiol* 18 293-296, September 1945

The eggs of the Bombyx Mori (silkworm) are suitable for research because they are robust, easy to handle, and their radiosensitivity is in the range of human cells

SYDNEY J HAWLEY, M D

**The Synchrotron—A Proposed High Energy Particle Accelerator** E M McMillan *Phys Rev* 68 143-144, September 1945

**Radiation from a Group of Electrons Moving in a Circular Orbit** E M McMillan *Phys Rev* 68 144-145, September 1945

The author describes briefly in a letter to the editor a new type of accelerator to give 300-million volt electrons In a cyclotron a particle whose angular velocity is just right to match the accelerating frequency is in "phase stability," being pulled up if it lags and held back if it gets too far ahead The equilibrium speed increases with the magnetic field and with the frequency A group of electrons (or positive ions) can therefore be accelerated by increasing either of these gradually enough so that they never fall out of step The similarity to a synchronous motor suggested the name synchrotron The magnet is of less size than for a cyclotron, because only a circular band is required, not the whole circular area of poleface The magnetic flux needed is only about 1/5 that needed for an equal beta tron The author has calculated dimensions for a 300-million-electron-volt synchrotron which he is planning magnetic flux (peak) 10,000 gauss, final radius of orbit 100 cm, frequency 48 megacycles per sec, injection energy (electron gun) 300 kv, initial radius of orbit 7.5 cm Relativity effects do not put a ceiling on possible energies as they do for the cyclotron

In a second communication the author calculates the energy lost by radiation by the whirling electrons in a synchrotron designed for 300 million volts He finds radiation from a single electron 780 volts per turn, and for close groups of electrons, per electron, 1,400 volts per turn This is thus no barrier to attaining the expected energies (This effect is a serious one for the betatron and limits the energies attainable from such machines)

R R NEWELL, M D



ally changes into pigmentation, and after sixty days almost no difference can be noted between exposed and unexposed skin. The time of appearance, the rate of development, and the rate of subsidence of the erythema reaction are entirely independent of the total amount of radioactive phosphorus applied within the limits tested. For instance, whether 1.53 microcuries per square centimeter were applied for twenty-four hours or 2.15 microcuries per square centimeter for seventeen hours, the course of the reaction was the same. This holds true as well for higher amounts, unless the total exposure exceeds 1,500 microcurie hours per square centimeter.

Exposures of about 2,000 microcurie hours per square centimeter produced a more intensive erythema reaction from the onset on the third or fourth day after the beginning of application than did the smaller exposures. Eighteen to twenty-three days after the beginning of such exposure, a dry scaly epidermite occurred, which subsided in approximately thirty-five to forty-five days. This reaction left a slightly depigmented center with hyperpigmented edges about sixty to sixty-five days after the beginning of the exposure.

With an exposure exceeding 3,500 microcurie hours per square centimeter the initial appearance and intensity did not differ from those after exposures approximating 2,000 microcurie hours per square centimeter, but frequently a bullous epidermolysis resulted in sixteen to twenty days from the onset of exposure. Exposures to more than 4,000 microcurie hours per square centimeter always resulted in a bullous epidermolysis. After fifty to sixty days from the beginning of exposure, even up to 4,500 microcurie hours per square centimeter, the skin recovered. The site of exposure presented a depigmented central area with hyperpigmented edges. Repeated observation of the exposed areas for a period of more than three years has revealed that no late reactions occur when the dose does not exceed 3,500 microcurie hours per square centimeter. After six

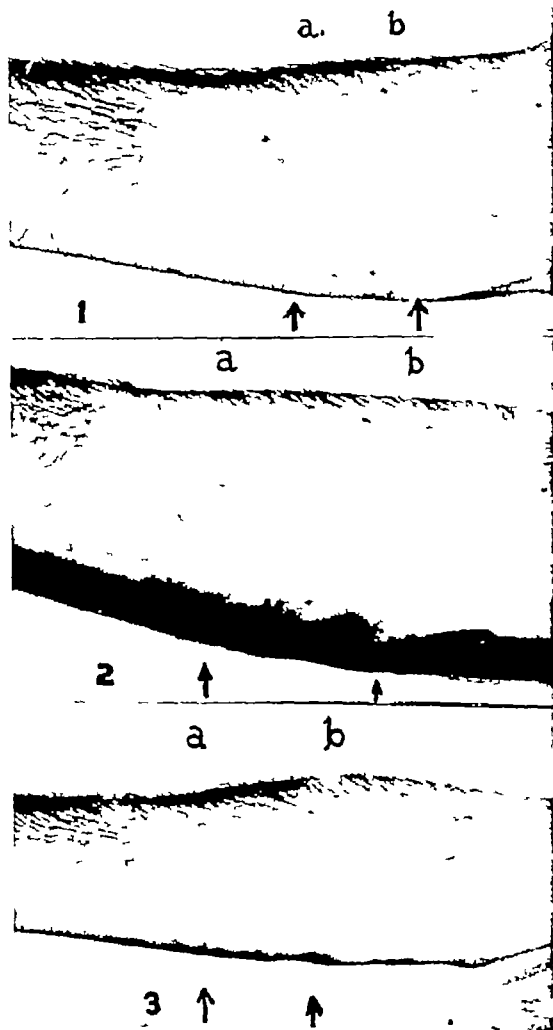


Fig 1 D M Reaction to 7.6 microcuries of  $P^{32}$  in blotting paper disk 4.9 cm<sup>2</sup>

Applied	Exposure	Estimated Dose in First mm Layer
(a) 24 hr	(a) 36 $\mu\text{c hr/cm}^2$	(a) 159 r $\beta$
(b) 48 hr	(b) 72 $\mu\text{c hr/cm}^2$	(b) 311 r $\beta$

1 Five days after beginning of exposure Erythema discernible at a and more intensive at b

2 Thirteen days after beginning of exposure The difference of intensity of erythema between a and b more marked. No subjective symptoms

3 Sixty eight days after beginning of exposure Almost no difference noticeable between irradiated and non irradiated skin

months those subjects who were exposed to more than 3,500 microcurie hours per square centimeter, and who reacted with an epidermolysis, showed slight dimpling of the skin in the area which had been exposed to radiation. No late reaction of telangiectasia has been observed in the three-

the arms and forearms Twelve subjects were studied in this series, and from three to five disks were applied on each subject, approximately 3 cm apart Three were applied on the forearm and two on the arm Each blotting paper disk was held in place, in contact with the skin, by zinc oxide type adhesive tape an inch in width, which entirely covered the disk Three subjects had exposures on both arms and forearms, 9 subjects on one arm and forearm only A total of 69 exposures were made Only 62 of these could be evaluated, however, since two of the subjects unintentionally removed some of the disks before the contemplated time One inadvertently moistened three disks on the forearm while washing Equal activities were applied for various lengths of time on any one subject Different amounts were applied to the respective subjects, 1.53, 2.15, 8.1, 10.2, 20.4, 40.8, 61.2 microcuries per square centimeter being used

The amounts of radioactivity listed here are not corrected for absorption within the vehicle Experiments have shown that, when equal amounts of radioactive phosphorus were spread on equal areas of blotting paper and cellophane foil, the measured activity of the blotting paper was 15 per cent less than that of the cellophane This difference is due to absorption within the blotting paper used in these studies For blotting paper of different weight the "self-absorption" must be determined and corrected to reproduce the reactions described in this study

Investigations were undertaken to determine whether the adhesive tape with which the blotting paper was held in place was responsible for any "reflected" radiation No difference could be detected with or without adhesive tape backing

Consideration was given to the possibility that secondary x-rays ("Bremstrahlung") might result from the interaction of the beta particles with the blotting paper and the tissues Because of lack of facilities, however, this question was not investigated The physical and geometrical factors in these studies were constant

enough so that if secondary x-rays were of any practical significance, they were always proportional to the total radiation dissipated under the particular conditions

First consideration was given to determination of the smallest amount of radiation which would produce discernible erythema Ten exposures varying from 16 to 33 microcurie hours per square centimeter produced no erythema All six exposures (on four subjects) of 34 to 36 microcurie hours per square centimeter produced a faint but discernible erythema The four exposures of 37 to 40 microcurie hours per square centimeter, on four different subjects, produced a frank erythema The "threshold erythema dose," therefore, may be accepted as approximately 34 microcurie hours per square centimeter

The amount of radiation necessary to produce an epidermolysis was the next consideration A dry epidermite was produced by exposures to at least 1,950 microcurie hours per square centimeter All six tests with 1,950 to 2,100 microcurie hours per square centimeter produced a dry epidermite A bullous wet epidermolysis resulted from exposures of 4,100 to 4,500 microcurie hours per square centimeter in the four subjects tested

The reactions were observed from the third or fourth day after beginning of the exposure, daily for sixteen days, then every third day up to the thirtieth day, twice a week between the thirtieth and sixtieth day, and once in two weeks between the sixtieth and ninety-fifth day In some of the subjects, particularly those with large exposures, more frequent inspections were made In order to detect late reactions, the subjects have been seen in six- to eight-month periods and are still being followed

When the dose does not exceed 1,500 microcurie hours per square centimeter, the erythema occurs approximately three to five days after the beginning of exposure, increases in intensity up to the fourteenth to sixteenth day, and subsides in approximately thirty days The erythema grad-



to which a blotting-paper pad, 4.9 sq. cm., containing 300 microcuries of radioactive phosphorus had been applied for 72 hours (4,400 microcurie hours per square centimeter). The biopsy was done thirty-five days after the onset of exposure. The histologic findings are described by Dr. Warren L. Bostick as follows:

**"Gross Description"** Section from the right arm is a full-thickness skin specimen which extends to the underlying adipose tissue. At one end of the section there is desquamated, pale, atrophic skin. On the other end of the section the epithelium of the surface is grossly not remarkable.

**"Microscopic"** In one half of the section the epithelium is atrophic with thinned keratin layer, stratum granulosum, and malpighian layer. There is some separation in the dyskeratotic areas by a serous fluid. In the stratum spinosum there is evidence of moderate edema and prominent intercellular bridges. In the superficial dermis there are edema, hydropic collagenous fibers, and very little evidence of increased cellularity. Scattered round cells are noted, as well as occasional eosinophils. In the deeper dermis the sweat glands, the sebaceous glands, the hair follicles, and the arrector pili muscles are seen to be atrophic, with surrounding fibrosis and lymphocytic cells. Throughout the whole thickness of the dermis there is edema with swollen endothelial cells and fibrocytes, with relative, although not absolute, decrease in collagen, elastic fibers, and reticulin. The endothelium of the capillaries appears swollen. The luminal size of the vessels is decreased, producing relative avascularity. The evidence of the cellular reaction extends to the whole 5-mm. thick specimen.

"In contrast, the adjacent non-irradiated areas of the section reveal a full thickness of the normal squamous epithelium showing a slight edema and keratin desquamation. In the dermis there is more vigorous reaction, with many lymphocytes, plasma cells, and eosinophils. The stroma is rather dense, with increased collagen, elastic fibers, and reticulin being produced by prominent fibroblasts."

**"Summary"** In the irradiated areas the histological picture is one of some desquamation of the epithelium with cellular changes in the epidermis, some atrophy, and edema of the tissues of the dermis with a predominant picture of inhibited fibroblastic, endothelial, and inflammatory reaction. This relative inhibition of the full normal inflammatory reaction is best compared with the adjacent non-irradiated tissue, where the reaction of leukocytes and fibrosis is much more abundant. The abnormal tissue changes extend to the lower margin of the section.

These microscopic findings (Figs. 4 and 5) indicate that the biological depth effect on the skin, of beta radiation from externally applied radioactive phosphorus during

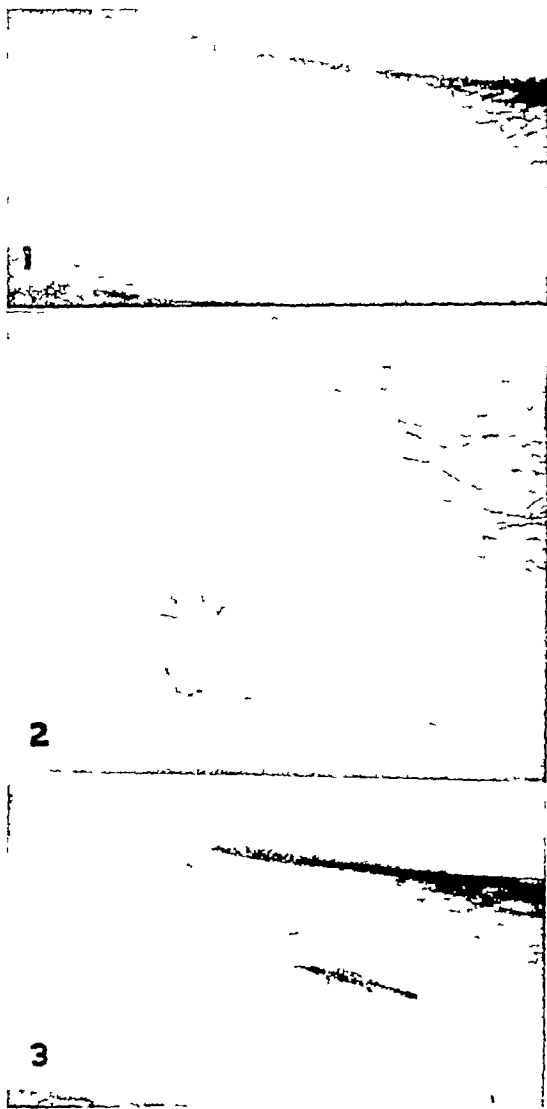


Fig. 3 A W A Reaction to 300 microcuries of  $P^{32}$  in blotting paper disk 4.9 cm<sup>2</sup> applied for 72 hours

Exposure

4320  $\mu\text{C hr/cm}^2$

Estimated Dose  
in First mm. Layer  
17,000 r<sub>p</sub>

1 Seven days after beginning of exposure. Marked erythema with some edema in the center.

2 Twenty-five days after beginning of exposure. Marked erythema with wet epidermolysis. Some tenderness.

3 Fifty-eight days after beginning of exposure. Skin recovered, some pigmentation. Healing scar from biopsy taken 35th day after beginning of exposure.

the acute phase of the reaction, extends to at least 5 mm. when the surface reaction is a bullous epidermolysis.

B. N. H. 69 year old male. Biopsy from skin of left arm to which a blotting pad, 4.9 sq. cm., con-

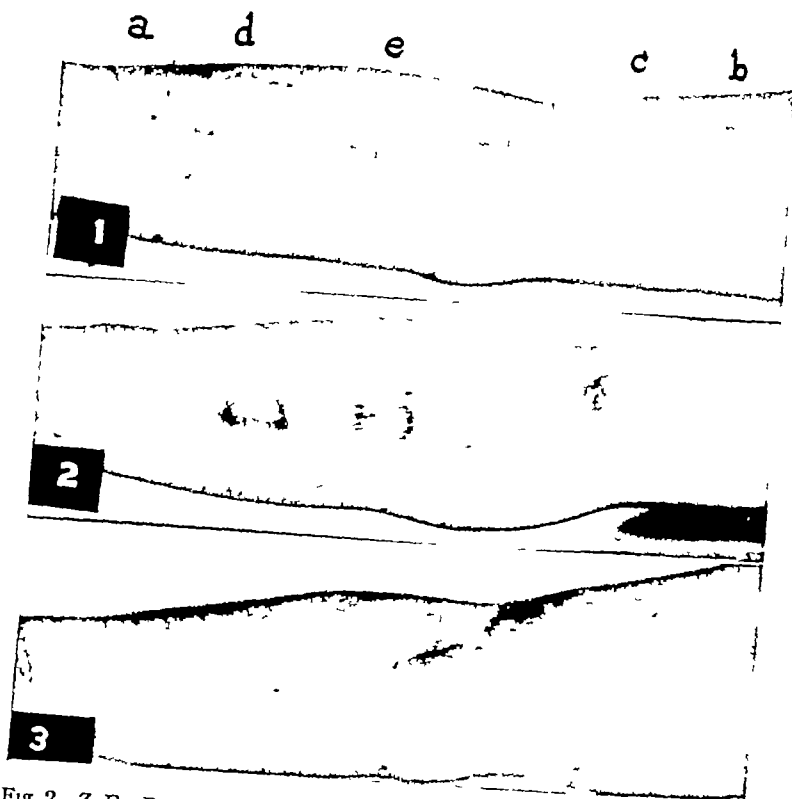


Fig 3 Z E Reaction to 100 microcuries of  $P^{32}$  in blotting paper disk  $4.9 \text{ cm.}^2$

Applied	Exposure	Estimated Dose in First mm Layer
(a) 12 hr	(a) $240 \mu\text{c hr/cm}^2$	(a) 1050 r $\beta$
(b) 24 hr	(b) $480 \mu\text{c hr/cm}^2$	(b) 2070 r $\beta$
(c) 48 hr	(c) $960 \mu\text{c hr/cm}^2$	(c) 3950 r $\beta$
(d) 72 hr	(d) $1440 \mu\text{c hr/cm}^2$	(d) 5650 r $\beta$
(e) 96 hr	(e) $1920 \mu\text{c hr/cm}^2$	(e) 7200 r $\beta$

1 Seven days after beginning of exposure The distinctness of the erythema in the five areas is in proportion to the dose

2 Thirty days after beginning of exposure Some pigmentation at a and b Marked marginal pigmentation at c, d, and e, with scaling of the skin at c and e Some itching at c, d, and e

3 Sixty-four days after beginning of exposure Areas a and b almost indiscernible Residual pigmentation at c, d, and e No subjective symptoms

year observation period, but this does not preclude the possibility that a late reaction may still develop

Figures 1, 2, and 3 show the course of the erythema reaction in three of the subjects

The depth effect of the beta radiation from externally applied radioactive phosphorus was next studied. Although the erythema reaction unquestionably indicated a radiation effect on the subpapillary plexus, it appeared advisable to investigate the extent of the depth effect by means of microscopic studies. Through the cooperation of Dr Frances Torrey of the

Department of Dermatology and Dr Glenn Bell, Department of Surgery, of the University of California, skin biopsies at least 5 mm thick were taken from irradiated and adjacent non-irradiated areas in the following two cases. The specimen from the first case was taken during the acute phase (35th day) of a severe epidermolytic reaction, and the specimen from the second case was taken during the late phase (215th day) of a less severe epidermolytic reaction.

A A., 64-year-old male. Biopsy from right arm. The specimen was taken from the skin of the arm

the reaction (Figs 6 and 7) are detectable to a depth of 2 mm with exposure to 3,150 microcurie hours per square centimeter

#### ESTIMATION OF DOSAGE

The curie is the generally accepted unit for radioactivity, and refers to  $3.7 \times 10^{10}$  particle disintegration per second. The curie and its fractions, the millicurie ( $3.7 \times 10^7$  particles/second) and the microcurie ( $3.7 \times 10^4$  particles/second), do not provide information about the source of the radiation nor about the energy dissipated. The unit "roentgen," on the other hand, gives information about the energy dissipated.

L. D. Marinelli and P. Aebersold (6, 7) have calculated the energy dissipated by a given amount of radioactive phosphorus in equivalent roentgens. In twenty-four hours 1 microcurie dissipates approximately 429 r (Marinelli) per gram of tissue. This calculation is based on the assumption that 1 microcurie of radioactive phosphorus is incorporated in 1 gram of tissue and that the energy dissipated is completely utilized within this unit mass of tissue.

Calculation and measurement of the energy dissipated by surface application of radioactive phosphorus constitute an involved problem, and only an estimate of the dose in equivalent roentgens can be given at this time. When radioactive phosphorus is distributed over a surface, only one-half of the beta particles radiate toward the surface, while the other half radiate away from the surface. The number of beta particles emitted in the first twenty-four hours from 1 microcurie of radioactive phosphorus is  $3.26 \times 10^9$ . The number of beta particles acting on the skin from 1 microcurie of radioactive phosphorus applied to the skin in the first twenty-four hours is

$$3.26 \times 10^9 \times 1/2 = 1.6 \times 10^9$$

Half-value layer measurements have shown that about 48 per cent of the radiation of radioactive phosphorus is absorbed in the first millimeter of water or tissue and



Fig 6 B. N. H., male. Photomicrograph of the skin  $\times 616$ . Biopsy from irradiated and non-irradiated skin on the 215th day after beginning of exposure to 3,150 microcurie hours of  $P^{32}$  per  $cm^2$ . Clinically atrophic late phase after partially bullous, partially dry epidermitis with marginal pigmentation and central depigmentation. The upper photomicrograph (C C) shows thin, dyskeratotic epithelium. The papillae are entirely flattened. The dermis shows extensive chronic inflammation. No hair follicles or sebaceous glands are visible, coils of sweat glands are present. Relative avascularity. In contrast the lower photomicrograph (D D) shows normal skin.

that the absorption is practically exponential (8). When the surface area of distribution is 1 sq cm and the thickness of the tissue is 1 mm, the number of particles necessary to deliver an energy equivalent to 1 roentgen in 0.1 gm of tissue is  $7.46 \times 10^6$ . Consequently, the estimated number of roentgen equivalents dissipated in the first millimeter of tissue is 4.3 per hour per microcurie per square centimeter area.



Fig 4 A A male. Photomicrograph of skin  $\times c 10$  Biopsy specimen taken from irradiated and adjacent non-irradiated skin on the 35th day after beginning of exposure to 4,400 microcurie hours per square centimeter of  $P^{32}$ . Clinically desquamating phase of acute bullous epidermolysis. The right half of the photomicrograph shows desquamated keratin layer, atrophic, thinned stratum granulosum, and malpighian layer of the epidermis edema of the dermis. In contrast, the left half of the section, from skin not exposed to radiation, shows normal squamous epithelium and dense stroma of the dermis.



Fig 5 Details from sections indicated in Fig 4 as A A and B B  $\times c 80$ . The right half shows area A A, which was exposed to radiation. The stratum spinosum of the epithelium shows moderate edema and prominent intercellular bridges, edema of the superficial dermis with hydropic collagenous fibers, marked narrowing of the vessels with swollen endothelium of the capillaries. In contrast, the left half of the photomicrograph shows the area B B, not exposed to radiation.

taining 129 microcuries of radioactive phosphorus was applied for 120 hours (3,150 microcurie hours per square centimeter). On the 215th day after the onset of exposure the biopsy was taken. The histologic findings, described by Dr Warren Bostick, were as follows:

**Gross Description.** The section is a full thickness skin specimen. The surface shows an atrophic thin epithelial layer. The papillae are entirely flattened. The section of the specimen not exposed to radiation reveals no abnormalities.

**Microscopic.** The section of the skin specimen from the irradiated area has an atrophic and desquamating dyskeratotic surface which contains several superficial vesicles. The layers of the epidermis are indistinct, thinned, and poorly formed. The rete pegs are thin, shortened, and with poorly defined basal membranes. There is very extensive hydropic cellular degeneration. The superficial and interpapillary dermis shows extensive chronic inflammation and fragmentary degeneration of the reticulum and fine collagen fibrils. Swollen fibroblasts and plump endothelial cells, with relative decrease in vascularity, are noted. This change extends to about one half of the depth of the sweat glands. No hair follicles or sebaceous glands are noted, but coils of sweat glands are present. They show no atrophy but slight surrounding fibrosis. The deepest level with evidence of remaining abnormal reaction lies 2 mm below the surface and is in the form of slight chronic perivascular inflammation. Below this level there are no abnormal changes in the stromal fibrillary structure.

**Summary.** There is abundant evidence of chronic inflammation together with striking epithelial cellular abnormality and atrophy and with surface degeneration of the stromal fibrils.

The tissue changes in the late phase of

TABLE I

Reaction	Size of Blotting Paper Disk (cm <sup>2</sup> )	Exposures		Estimated Dose in r <sub>β</sub> in First mm layer
		Micro-curie Hours	Micro-curie Hours per cm <sup>2</sup>	
Threshold erythema	4 9	168	34	143
Dry, scaly epidermite	4 9	9,600	1,900	7,200
Bullous, wet epidermite	4 9	21,600	4,400	17,000

epidermite dose is approximately 7,200 r<sub>β</sub> ( $4.3 \times 1,900$ ), and the bullous epidermolysis dose is approximately 17,000 r<sub>β</sub> ( $4.3 \times 4,400$ ), when the exposure figures are corrected for decay of the P<sup>32</sup> during the exposure

#### DISCUSSION

The studies reported here demonstrate that beta radiation from radioactive phosphorus applied externally by means of blotting paper disks produces varying degrees of skin erythema, or damage, depending upon the amount of energy dissipated. This may be estimated in roentgen equivalents. The skin reaction appears to be monophasic, it gradually reaches a peak and subsides, leaving either pigmentation or depigmentation, depending on the dose delivered. This finding is contrary to that described by Wilhelmy (10). According to Wilhelmy, exposure of the skin to low-kilovoltage x-rays or cathode rays is followed by a biphasic reaction, namely, early erythema, perceptible within eight days after exposure, an interval during which no erythema is visible, and a main erythema reaction which occurs from three to four weeks after the exposure. In none of the cases studied following exposure to radioactive phosphorus was a biphasic reaction observed. There is no reason to believe that the monophasic reaction is a peculiarity of the exposure to radioactive phosphorus beta particles, and no explanation can be offered for the different (*i.e.*, biphasic) reaction observed by Wilhelmy.

The biological effect of beta radiation on the skin from externally applied radio-

active phosphorus is similar to the effect obtained from unfiltered radium plaques or cathode rays. However, the therapeutic utilization of cathode rays and beta radiation from radium has not gained general acceptance. One of the reasons might be that neither of these sources provides pure beta radiation. The treatment with cathode rays, moreover, necessitates elaborate equipment.

The physical properties of radioactive phosphorus, the ease with which it can be applied by means of blotting paper pads, and the possibility of accurate determination of the dosage suggest that radioactive phosphorus may be an ideal means for utilization of beta radiation for the local treatment of certain superficial skin diseases.

#### SUMMARY

1 Radioactive phosphorus applied to the skin produces erythema showing a characteristic monophasic course. The intensity of the erythema depends on the amount of exposure.

2 The depth of discernible biological effect from externally applied radioactive phosphorus is approximately 5 mm for erythema-producing doses.

3 "Threshold erythema" was produced by an exposure to 34 microcurie hours per square centimeter. Dry, scaly epidermite was produced by an exposure to 2,000 microcurie hours per square centimeter, and a bullous epidermite resulted from an exposure to 4,400 microcurie hours per square centimeter.

4 Thin blotting paper is a suitable vehicle for skin application of radioactive phosphorus.

5 The results of these studies suggest that the use of radioactive phosphorus in the local treatment of certain superficial skin diseases is reasonable.

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Fig 7 Details from sections indicated in Fig 6 as C C and D D  $\times 90$  The upper half shows area C C The papillae are entirely flattened, the epidermis is desquamating and dyskeratotic, with an intradermal vesicle The rete pegs are thin, the basal membrane poorly defined Chronic inflammation and fragmentary degeneration of the reticulum and fine collagen fibrils are visible in the dermis Endothelial cells are plump, with relative decrease of vascularity No sweat glands or hair follicles are seen In contrast, the lower half of the photomicrograph shows the area D D, not exposed to radiation

Actual measurements made on a flat surface ionization chamber calibrated against a Failla extrapolation ionization chamber have shown that the surface dose from 1 microcurie per square centimeter of radioactive phosphorus is 5.05 r per hour (9) When only the first millimeter of tissue is considered, the estimated dose is

$4.3 r_B^*$  Thus there is fairly good agreement between the dose measured on the surface and the dose estimated in the first millimeter of depth Consequently, the threshold erythema dose is approximately  $143 r_B$  ( $4.3 \times 34$ ), the dry scale

\* Henceforth the symbol  $r_B$  is used in this study for roentgen equivalent from beta rays

TABLE I

Reaction	Size of Blotting Paper Disk (cm <sup>2</sup> )	Exposures		Estimated Dose in $r_s$ in First mm layer
		Micro-curie Hours	Micro-curie Hours per cm <sup>2</sup>	
Threshold erythema	4.9	168	34	143
Dry, scaly epidermite	4.9	9,600	1,900	7,200
Bullous, wet epidermite	4.9	21,600	4,400	17,000

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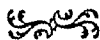
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# The Bone Changes of Leukemia in Children<sup>1</sup>

BERNARD S. KALAYJIAN, M.D.,<sup>2</sup> PETER A. HERBUT, M.D.,<sup>2</sup> and LOWELL A. ERF, M.D.<sup>4</sup>

LEUKEMIC BONE changes are for many reasons more common, more extensive, and more varied in children than in adults. In children leukemia is usually of the acute lymphatic type, while in adults the chronic types are more common (3). The marrow of all the bones is hyperactive in childhood, but only that of the sternum, ribs, and vertebrae at a later age, so that there is numerically more opportunity for leukemic infiltration of the bones and periosteum in children. The periosteum is less firmly attached to the shafts of long bones in early life so that it is more easily elevated and stimulated to new bone production. Bone metabolism is more active and more readily disturbed in the growing bones of children. The reserve blood-forming capacity, beyond normal demands on the bone marrow, is comparatively less in children than in adults. This reduced "margin of safety" is said by Poynton and Lightwood (15) to account for some of the skeletal changes seen in children with leukemia. In attempting to meet the overload demands of the disease, the body tries to increase its blood-forming capacity by expansion of the bone marrow and subsequent atrophy and erosion of the cortex.

Adults occasionally show leukemic bone changes. Craver and Copeland (5), in a radiographic study of 168 patients with leukemia, found 6 adults with demonstrable changes in the femur, sternum, humerus, pelvis, skull, metacarpals, ulna, and vertebrae in that order of frequency. Both osteosclerotic and osteoclastic changes were observed, although the latter predominated. Periosteal elevation and new bone formation were not seen. All the cases were of the leukopenic variety, and most

were lymphatic in type. A few others in the series showed autopsy evidence of leukemic infiltration in the bones not demonstrable roentgenologically. Leukemic bone changes in adults have also been reported by Wintrobe and Mitchell (22), Craver (4), Forkner (9), and others.

We have found in the available literature reports of 144 cases of leukemia in children with demonstrable bone changes: 138 cases were of the lymphatic type, 5 of the myeloid type, and 1 of the monocytoid type. In over 50 per cent of the series, the disease was of the leukopenic variety. The changes were of various kinds and occurred either singly or in combination in any given roentgen examination.

One of the most common bone changes in childhood leukemia is periosteal elevation with new bone formation along the shafts of the long bones. This appears as a linear area of increased density parallel to the shaft but separated from it. The new bone may be smooth in outline and fairly uniform in density or it may be irregular. It may extend the entire length of the shaft or over only a small segment, and may be on one side or may completely encase the shaft. Multiple layers of new bone parallel to each other and to the shaft are sometimes present. Poynton and Lightwood (15) believed that this represented a true splitting off of layers of the cortex, but others (6, 10, and 21) have shown it to be the result of leukemic infiltration under the periosteum, elevating it and stimulating new bone production. This new bone may be perpendicular to the shaft, as well as parallel with it, as noted by Karshner (11). Several bones are usually involved, and complete skeletal surveys should be made. Similar changes may be revealed at autopsy along the ribs, sternum, skull bones, and vertebrae, but they are usually demonstrable roentgenologically only along the long bones.

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Fig 1 Case 1 Original roentgenogram of legs, showing periosteal new bone formation, marrow expansion, and some cortical destruction along the shaft of the left fibula

They have been described by Taylor (21), Kareltz (10), Karshner (11), Poynton and Lightwood (15), Smith (17), Erb, Snelling and Brown (7), Sutton and Bosworth (20), and others

Accompanying the periosteal changes, or appearing separately, is evidence of expansion of the marrow cavity by leukemic infiltration. This results in erosion and thinning of the cortex with generalized bone demineralization. Pathological fractures have been reported. Radiographically, this type of change may be localized to one part of a long bone or unevenly distributed throughout the length of the shaft. There are areas of irregularly decreased density and destruction. The cortex may be atrophic in many areas or it

may be apparently thickened due to leukemic infiltration. The density is usually reduced, and the trabecular markings appear more prominent than normal because of absorption of some of the finer trabeculae. These latter changes are the ones more commonly observed in the skull and flat bones.

Baty and Vogt (1) described transverse bands of decreased density across the growing ends of long bones in over 70 per cent of 60 children with leukemia who were studied radiographically. The change was due to leukemic infiltration in these areas of active bone metabolism and was likened by the authors to the *Trümmerfeld zone* of scurvy.

Osteosclerotic changes do occur in leukemia, as noted by Mendl and Saxl (13), and others. They are, however, less common in children, are late changes, and probably represent an attempt at healing of the earlier destructive changes or are the result of maturation of leukemic cells into osteoblasts. Bone cysts and tumors have been found associated with leukemia but are not common.

None of the changes described can be said to be specific for leukemia, as syphilis, osteomyelitis, tuberculosis, typhoid fever, fractures, rickets, scurvy, neuroblastoma, multiple myeloma, Ewing's tumor, lymphosarcoma, and other diseases may produce similar roentgen changes. The age of the patient, history, blood studies and other laboratory examinations, symptomatology, number of bones involved, bone marrow studies, and findings on bone biopsy will all aid in the final diagnosis. In many instances, however, in which the clinical evidence may be equivocal and indefinite, the peripheral blood studies normal, and the other laboratory evidence unconvincing, the roentgen picture will reveal sufficiently suggestive findings to stimulate bone marrow studies and biopsy to confirm the diagnosis. Neither the cause nor the cure for leukemia is known at present, but the earlier the diagnosis is made, the more time there is for study and for therapeutic efforts.

which will eventually result in discovery of a cure

We are here presenting the clinical, radiological, hematological, and pathological findings in two cases of proved lymphatic leukemia in children, to reiterate the need for more careful studies and correlation of effort for earlier diagnosis in this disease

CASE 1 H S, a 16-year-old white boy, began to have profuse nocturnal perspiration in December 1944. Shortly thereafter, he complained of head-

only positive laboratory findings were rapid sedimentation of red cells and 10 per cent lymphoblasts in a smear of the sternal marrow. The latter was deemed of no consequence in view of the normal peripheral blood findings. Slight enlargement of the inguinal lymph nodes and a "hemic" apical systolic heart murmur without signs of cardiac enlargement were the only significant physical findings. During a stay of four months in the hospital to which the patient was first admitted, he was given salicylates, sulfonamides, and penicillin in dosages to tolerance, without perceptible benefit. Several whole blood transfusions produced some temporary symptomatic improvement.



Fig 2 Case 1 Cells of sternal marrow obtained by puncture. The majority of the cells are lymphoblasts. A Edge of a megakaryocyte. B Lymphoblast in mitosis. C Normoblast. D Myelocyte.

ache and migratory pains in the bones, joints, and muscles of his extremities and jaw, and subsequently of weakness and anorexia as well as daily fever. The fever was intermittent, ranging from 99 to 103°, with afebrile periods as long as a week. Except for a transitory leukocytosis (12,000, with a normal differential count), the blood picture was normal. Radiographic studies of the chest, abdomen, teeth, sinuses, ulna, and mandible were reported as showing no pathological changes. Studies had not been made of the legs at the original examination, although the patient complained of severe pains along the shin bones. Urinalysis, blood chemistry studies, multiple agglutination tests, Wassermann test, and blood cultures were all negative. The

The date of admission to Jefferson Hospital was April 14, 1945. At that time the patient appeared pale, weak, listless and chronically ill but showed no petechiae or evidences of hemorrhage. The heart findings were as noted above. The spleen and liver were not enlarged. A few "slightly" lymph nodes could be felt in each groin. There was tenderness to pressure over the bones and muscles of the legs. Peripheral blood studies on admission showed a moderate secondary anemia and a slight leukocytosis (10,600) with an essentially normal differential count. Repeated white counts and differential counts in the first few days showed no significant variation from the admission studies.

Three days after admission, roentgen studies of



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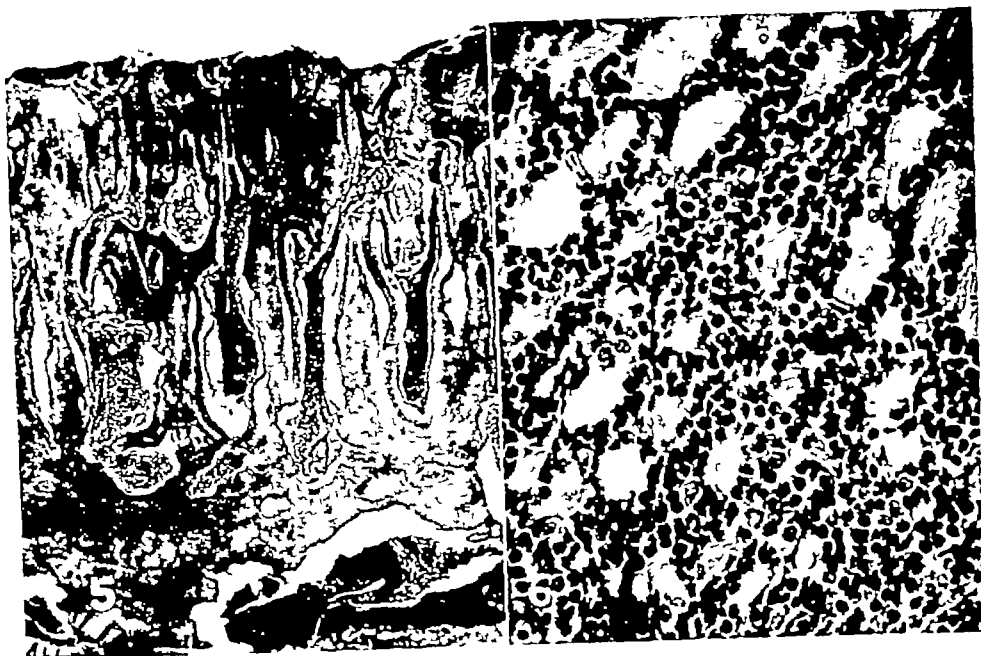
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Figs 5 and 6 Case 1 To the left (Fig 5) is a section of the left fibula This section shows, from below upwards, the outer limits of the old bone, the perpendicular spicules of new bone, and a parallel layer of new bone peripherally The periosteum has been removed The infiltrating cells are largely of the lymphoid series Hematoxylin and eosin  $\times 375$

To the right (Fig 6) is a section of muscle This section was taken from the muscle adjacent to the left fibula and shows diffuse infiltration with lymphoblasts Hematoxylin and eosin  $\times 400$

2,210 gm, revealed accentuated lobular markings and no tumors Each kidney weighed approximately 670 gm The capsules stripped easily, leaving diffusely pinkish gray surfaces studded with petechiae and irregular hemorrhages Cut surfaces showed, in addition, a complete disappearance of the normal demarcations and hemorrhages into the pelves In the mucosa and submucosa of the small intestine were numerous tumors measuring as much as 3 mm in diameter The superficial portions of many of these were ulcerated and covered with coagulated blood Throughout the lungs there were hemorrhagic areas measuring up to 1 cm across The periosteum of the left fibula was gray and broadened, measuring 2 mm in thickness It stripped without difficulty from the cortex of the bone, leaving a rather rough and porous surface The cortex of the fibula was very dense and measured 6 mm across whereas the medullary cavity was filled with soft gray tissue and measured 3 mm in diameter Firm gray tissue not only completely replaced the sternal marrow but in some areas eroded the cortex and adjoining cartilages The marrow of all the ribs and vertebrae was crowded with similar gray tissue in which the bony trabeculae were seen to be definitely decreased

Histologic sections of the left fibula obtained at biopsy and autopsy disclosed a complete replacement of the normal marrow with lymphocytic cells These were relatively large and round, exhibiting scanty almost imperceptible cytoplasm and round, evenly

stained nuclei In some areas there were in addition necrosis, hemorrhage, and early fibrosis The bony trabeculae were plentiful and did not appear depleted The cortex was composed of broad, dense bone whose interstices and haversian canals were completely filled with cells similar to those in the medulla Beyond the original and still relatively normal cortex was a layer of leukemic infiltrate about 0.5 mm thick in which there were regularly spaced, broad, perpendicular spicules of new bone (Fig 5) These in turn were covered externally with a continuous wider layer of dense bone whose interstices and haversian canals, like those of the cortex, were filled with leukemic cells The periosteum was represented by strands of dense acellular fibrous tissue Between it and the bone, and within the periosteum itself, were collections of lymphocytic cells often arranged parallel to the surface of the bone The muscles and connective tissue adjacent to the periosteum were diffusely infiltrated with round cells that appeared slightly larger than those within the marrow cavity (Fig 6) None of the lymphocytic cells showed mitosis Sections of the sternum and ribs disclosed a similar process except that in the former the periosteum was widely separated from the underlying bone by the proliferating cells In each there was new bone formation at the points where the periosteum was being separated from the old bone Sections of the vertebrae disclosed a complete replacement of the normal marrow with lymphoblasts and occasional lymphocytes,



Figs. 3 and 4. Case 1. Later radiograph of forearms, showing changes similar to those in the fibula. Fig. 4 is a close-up of the radius and ulna shown in Fig. 3.

the legs were made (Fig. 1). These showed definite periosteal elevation and new bone formation along the entire shaft of the left fibula. There were also some "patchy" decrease in bone density and cortical atrophy. Similar but less extensive changes were noted in the right fibula, but the tibia appeared unaffected on either side. The obscurity of the clinical picture and the absence of positive blood findings made the differential diagnosis rather difficult, but it was believed that leukemia in an aleukemic stage was a good possibility and the diagnosis was made on the basis of this film.

On the following day, a sternal puncture was done. Smears of the material obtained (Fig. 2) showed the vast majority—81 per cent—of the white cells to be lymphoblasts of atypical shapes with extremely bizarre nuclei. The impression was aleukemic lymphatic leukemia.

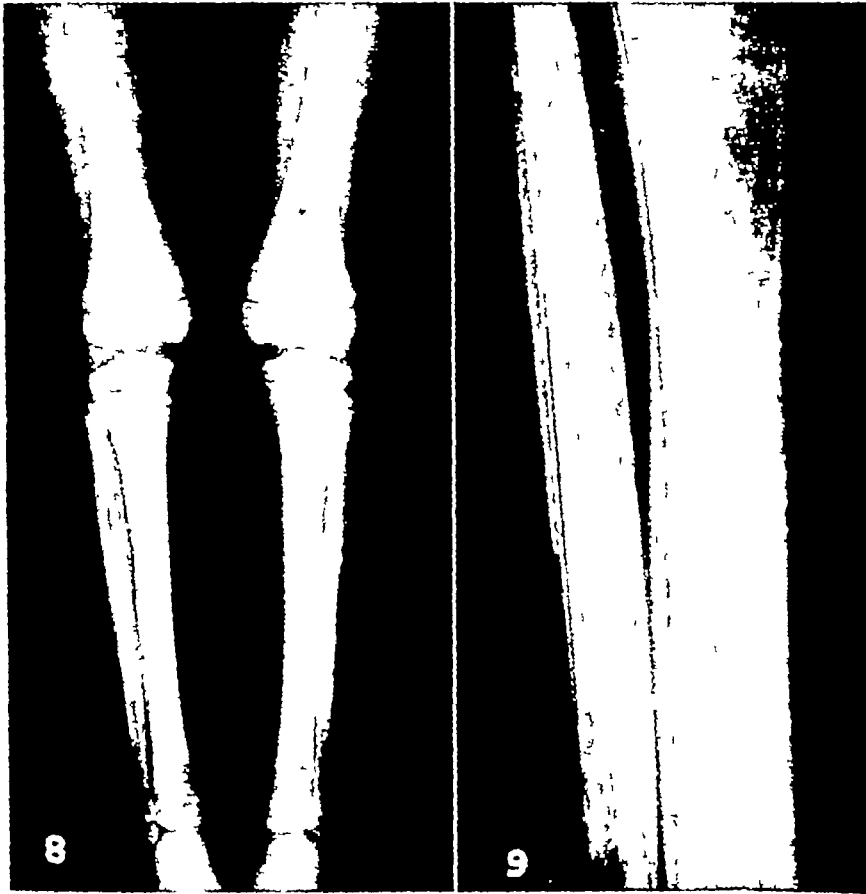
Additional roentgen studies of the extremities and other parts of the skeleton showed similar changes along the shafts of the radius, ulna, and humerus on each side (Figs. 3 and 4). The bones of the hands, skull, spine, ribs, and pelvis showed some osteoporosis and slight increase in prominence of the trabecular markings but no periosteal elevation or new bone formation.

Two weeks after admission a biopsy of the left fibula was performed. The findings were compat-

ible with a diagnosis of lymphatic leukemia, but not specific for it.

Although the peripheral blood findings remained fairly normal for some time, the clinical signs of lymphatic leukemia developed quite rapidly in the next five weeks. Two weeks after admission, the white blood cell count was 9,000, with 5 per cent lymphoblasts; on the day before death, the count had risen to 27,000, with 83 per cent lymphoblasts. The pain in the legs, arms, back, and jaws became very severe. The liver and spleen finally became enlarged, but the lymph nodes remained "shotty." No further signs of cardiac disease were elicited. Terminally, the patient bled from the gastrointestinal and urinary tracts. Death occurred on June 9, 1945.

At necropsy, the skin over the entire body disclosed numerous petechiae and several areas of ecchymosis measuring as much as 4 cm in diameter. The mucous membrane of the mouth was covered with coagulated blood. The peripheral and deep lymph nodes were enlarged to as much as 2 cm in diameter but were nevertheless well encapsulated, moderately firm, and on section diffusely gray. The spleen weighed 890 gm. It was firm and tense and on section presented a glistening, solid, beefy surface with complete loss of the normal follicular markings but no infarcts or tumors. The liver, weighing



Figs 8 and 9 Case 2 Fig 8 Postmortem roentgenogram of legs, showing periosteal new bone in layers along both tibiae and fibulae, as well as cortical osteoporosis and marrow expansion Fig 9 Close-up of one section of Fig 8, showing details of bone changes

hyperplasia without serious disruption. This is consistent with, but not necessarily diagnostic of, lymphatic leukemia and not inconsistent with infectious mononucleosis." The gross diagnosis at the time of necropsy was "acute lymphatic leukemia, splenomegaly, abdominal and retroperitoneal lymphadenopathy, hyperplasia of the lymphoid tissue of the intestine, hemorrhages in the viscera."

There were available to us for histologic study sections of the liver, spleen, kidneys, lymph nodes, pancreas, sternum, vertebrae and fibulae. The distribution of the lymphocytic cells in these sections was essentially similar to that described in Case 1, except that in none of the organs except the bones was the process as severe. Sections of the fibula disclosed a complete replacement of the marrow with loose myxomatous connective tissue in which were enmeshed lymphocytes and lymphoblasts. Myeloid elements appeared completely absent and there was a definite depletion of the bony trabeculae. The cortex of the old bone was broad and dense and disclosed within the haversian canals and interstices an

infiltration of tissue similar to that seen in the marrow. Immediately beyond the confines of the old bone was a relatively broad band of leukemic infiltrate which was richer in lymphocytes and lymphoblasts than was the marrow and which in its inner portion was almost entirely free of bone (Fig 12). Its outer portion, however, contained many spicules of new bone deposited at right angles to the shaft. The centers of these were composed of mature bone, while the peripheral portions were covered with a rim of osteoid tissue and this in turn was surrounded by a thin layer of osteoblasts. Osteoclasts were not seen. The outer rim of the perpendicular spicules was in some areas covered with a broad band of dense bone deposited parallel to the shaft, in other areas, it was covered directly with a normal or thickened and cellular periosteum. Both the latter and the adjoining fascia and muscles were irregularly infiltrated with lymphoblasts and fewer lymphocytes. Sections of the sternum and vertebrae disclosed a complete replacement of the marrow by lymphoblasts, scattered lymphocytes, and many

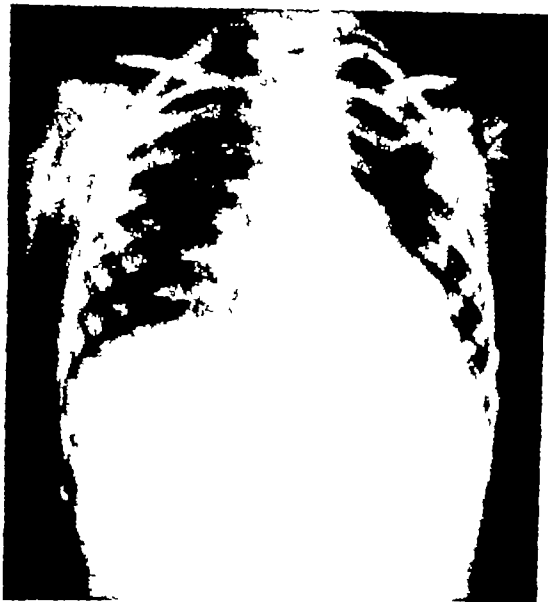


Fig 7 Case 2 Original roentgenogram of the chest. Note the periosteal new bone formation along the humeral shafts. This is much more clearly shown on the original film than on this reproduction.

absorption of the bony trabeculae, and deposition of hemosiderin, but no necrosis or fibrosis.

Histologic sections of other organs revealed changes typical of lymphoblastic leukemia. In all areas, most of the infiltrating cells were lymphoblasts, but there were always present a few mature lymphocytes. The normal architecture of the lymph nodes and spleen was completely replaced with these cells and there were similar foci in the skin, intestine, lungs, endocardium, pericardium, adrenals, and testes. In the liver, the portal radicles contained solid aggregations of lymphoblasts, but between the liver cords there were also some lymphocytes, neutrophils, and immature myeloid cells. In the kidneys, the infiltration occupied the interstitial tissue and compressed the remaining renal elements. In addition to the lymphocytic cells, there were scattered nuclear fragments and neutrophils. Mitosis was seen only in the lymph nodes, and deposits of hemosiderin only in the spleen. There were no other contributory changes in any of the organs.

**CASE 2.** E. A., a 4-year old white girl, had fever, chills, and painful swelling of the joints in December 1942. The fever was transitory, ranging to 103°. The joint pains migrated from the feet to the shoulders, knees, and hands. Both fever and joint pains recurred every week to ten days. Symptomatic relief was obtained with aspirin and soda every four hours, and the patient became afebrile temporarily. As the symptoms continued to recur, the child became weaker, anemic, and lost weight. Five blood transfusions, together with iron and vitamin therapy,

produced only transitory improvement during the next three months. There was an occasional purpuric spot but no petechiae were seen.

The child was admitted to Roper Hospital, Charleston, S. C., on Feb. 19, 1943. She appeared pale, listless, somewhat edematous, and chronically ill. There was marked atrophy of the musculature and one large purpuric spot was present on the right knee. There was generalized discrete lymph node enlargement. The chest was normal to physical examination. The abdomen was distended and the spleen enlarged and firm. There were some tenderness of the left knee and swelling of the left foot, but otherwise the extremities were not remarkable.

Blood studies on admission showed a moderate secondary anemia and a white cell count of 11,000, with 90 per cent lymphocytes. Repeated counts in the next month showed little change aside from a decrease in the number of white cells to 3,200 and a later increase to 7,800. At no time was the admission figure exceeded. Immature large lymphocytes and some lymphoblasts were observed at times. Sternal puncture on March 3, 1943, showed 95 per cent primitive lymphoblasts, indicating lymphoblastic leukemia. Many agglutination tests, stool examinations, blood cultures, and other laboratory tests were negative. A Wassermann test and urinalysis produced no positive findings. Biopsy of a cervical lymph node showed "changes consistent with lymphatic leukemia, though not entirely diagnostic for it."

Radiographic study of the chest on April 3, 1943 (Fig. 7), showed no pathological changes in the heart or lungs but demonstrated general bone demineralization and definite periosteal elevation and new bone formation along the humeral shafts. A diagnosis of lymphatic leukemia or chloroma was suggested.

The child did not respond to any therapeutic measures and on April 29, 1943, showed signs of pneumonia bilaterally, with temperature of 103°. A chest roentgenogram confirmed the clinical impression of widespread lobular pneumonia. It was impossible to make additional radiographic studies at that time. Death occurred on May 1, 1943, and roentgenograms of the entire skeleton were made immediately postmortem. These showed generalized bone demineralization, expansion of the medullary cavities, cortical erosion, periosteal elevation, and new bone formation in layers along the long bones (Figs. 8-11). The bones of the skull, pelvis, vertebrae, and ribs showed osteoporosis and increased prominence of the trabeculae, but no subperiosteal new bone.

We are indebted to Drs. Lynch and Pratt-Thomas of the Medical College of the State of South Carolina for the gross autopsy diagnosis, the biopsy diagnosis, and material for microscopic study in this case.

Biopsy of a lymph node from the posterior cervical region was described as showing "diffuse lymph-



id periosteum Since periosteum has nerve fibers and nerve endings, leukemic infiltrations in and beneath it are usually associated with pain This was first described by Strauch (19) in 1913 The parents often state that the pain is "along the bones" rather than in or near the joints, although leukemic infiltrations and hemorrhages into the joints do occur and produce pain

If a child has persistent bone or joint pains which do not respond to adequate cyclylate therapy, one should think of leukemia Complete blood studies may confirm the diagnosis, but many of these patients have aleukemic, subleukemic, or leukopenic types of leukemia and one cannot depend entirely on the peripheral blood findings for the diagnosis Too often the clinician may dismiss a diagnosis of leukemia when peripheral blood studies are normal, or nearly so, as in Case 1 It is at this point that further investigation, by roentgen studies of the bones and by external marrow puncture, is indicated The aspiration of sternal marrow is quickly and safely carried out either in the office or home, with minimum discomfort to the patient The results from the study of this material are usually accurate, and the true state of affairs may be quickly revealed by this method when masked by other findings

The marrow smears must be interpreted in connection with the clinical findings "Bone pains" are likely to be due to leukemic infiltration of the periosteum, while "joint pains" are likely to be due to rheumatic fever Rarely the two diseases may occur simultaneously, as in the case cited by Ehrlich and Forer (6)

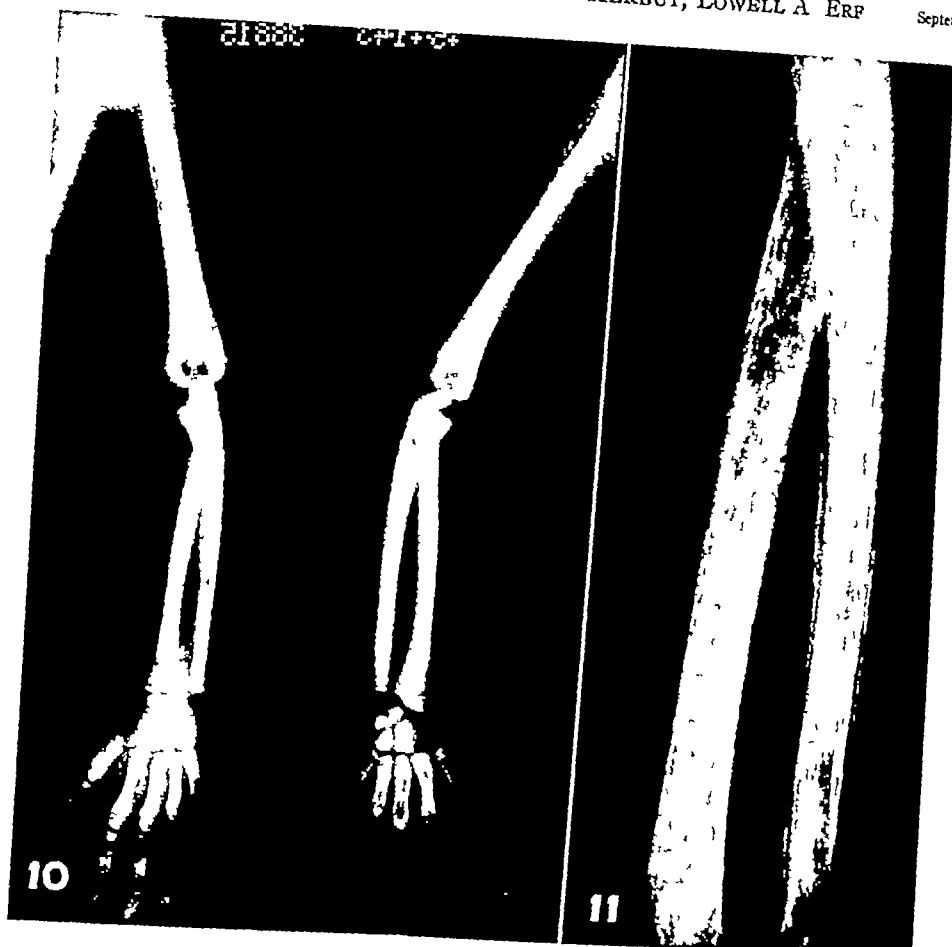
#### PATHOLOGICAL DISCUSSION

Pathologically, a definite diagnosis in Case 1 could not be made from a study of the biopsy of the left fibula At that time, there were no leukemic cells in the peripheral blood, nor were the spleen, liver, and lymph nodes enlarged Morphologically, therefore, the lesion was compatible with neuroblastoma, multiple myeloma of the



Fig 12 Case 2 Section of the fibula This section shows, from below upwards, the outer limits of the old bone, a band of leukemic infiltrate, perpendicular spicules of new bone and periosteum infiltrated with lymphoid cells Hematoxylin and eosin  $\times 375$

lymphocytic type, Ewing's tumor, lymphosarcoma, and lymphatic leukemia A diagnosis of neuroblastoma was dismissed on the grounds that the cells were a little smaller, contained less cytoplasm, and showed no rosette formation Against multiple myeloma were the age of the patient and the absence of definite tumors in the bones and of Bence-Jones proteinuria though, of course, the morphology of the cells was compatible with such a lesion Nor could a diagnosis of Ewing's tumor be eliminated Although the cells in the marrow were somewhat smaller than those ordinarily seen in Ewing's tumor, it was thought that the disparity in size could be accounted for by shrinkage produced by the decalcifying agent This explanation was even more plausible when one compared these cells with those infiltrating the periosteum and attached muscle, which were not decalcified The latter were definitely larger and were very similar to the cells seen in Ewing's tumor Thus although either lymphosarcoma or



Figs 10 and 11 Case 2 Postmortem roentgenogram of upper extremities. Changes similar to those in the legs are seen in the humerus, radius, and ulna on each side. The bones of the hand show demineralization, cortical atrophy, and prominence of the trabecular markings. Fig 11 Close up of radius and ulna in Fig 10 showing details of bone changes.

megakaryocytic cells. Myelogenous elements, although still present, were inconspicuous. The bony trabeculae were decreased and there was no evidence of excessive new bone formation at the periphery. The periosteum, in close apposition to the bone, contained only a few foci of lymphocytic cells.

The infiltrates in the remaining organs, as in the bones, consisted chiefly of lymphoblasts and a few lymphocytes. In the liver, they were confined entirely to the portal radicles. In the spleen, there were irregular foci both around vessels and independent of them, and in addition a more or less diffuse infiltration that varied in intensity. In the lymph nodes, there remained only a few recognizable follicles, the rest having been completely and diffusely replaced with lymphoblasts and lymphocytes. Throughout, however, the sinusoids were prominent and were filled with reticulum cells, rounded phagocytes, plasma cells, erythrocytes, and lymphocytic cells. Infiltrations in the kidneys were confined to the interstitial tissue of the cortex and contained, in

addition to the lymphoid cells, scattered plasma cells and reticulum cells. The renal parenchyma was not greatly compressed. There was no leukemic infiltration of the pancreas, and nowhere was extra medullary hemopoiesis recognized.

#### CLINICAL AND HEMATOLOGICAL DISCUSSION

Clinically, it may be difficult to differentiate acute leukemia in children from some other diseases, as, for example, acute rheumatic fever. In the earlier stages, the symptomatology and physical findings may be closely similar. The patients often complain of indefinite migratory bone pains. It must be remembered that leukemic cells infiltrate all tissues, including bones and periosteum. In 1899, Pinkus (14) described leukemic infiltration between bone

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ilar to the cells seen in Ewing's tumor  
Thus, although either lymphosarcoma or

lymphatic leukemia was the most probable diagnosis, lymphocytic multiple myeloma and Ewing's tumor could not be ruled out. It was obvious, therefore, that since an unequivocal diagnosis could not be made on a morphological basis, the subsequent clinical and roentgenologic developments were of the utmost importance.

The bone changes shown roentgenologically are due to leukemic infiltration of the bone marrow, cortex, and periosteum, with elevation of the latter and new bone production as shown by the morphological findings. The perpendicular spicules of bone so clearly shown histologically could not be differentiated as such on the roentgen films in these two cases, though they have been reported as noted above. The expansion of the bone marrow and cortical demineralization and destruction seen radiographically were not explained fully by the microscopic findings, although they must have been produced by the leukemic infiltration throughout the bone and marrow cavity.

#### RADIOLOGICAL DISCUSSION

The changes noted in the long bones in Case 2 were quite typical for leukemia as described in the literature. A definite differential diagnosis could not have been made from the original roentgenogram of the legs in Case 1 except for the similarity of the changes noted to those previously seen in Case 2. The complete absence of evidence of leukemia in the peripheral blood picture at the time the roentgen diagnosis was made in Case 1 led the clinicians to believe that such a diagnosis was probably incorrect, or at least very questionable. Sternal marrow studies aided materially in establishing the diagnosis, which was made unequivocal by the development of typical clinical features, together with the autopsy results.

We believe that the presence of intractable bone pain with absence of positive laboratory evidence of other diseases should more often instigate roentgen investigation of the long bones in children. Not all will show leukemic changes, by any

means, even when leukemia is present, but the frequency of definitive changes will be considerably higher than in adults. If, by suggesting the possibility of leukemia on the basis of roentgen findings, this makes possible an earlier diagnosis, we have gained time for research which will eventually result in discovery of a cure. It is our conviction, therefore, that it is better to make a diagnosis with a poor prognosis, even on relatively meager evidence and even though this be proved in error later, than to equivocate until the diagnosis becomes obvious and the opportunity for possible benefit to the individual patient and all future patients is lost.

#### SUMMARY

The clinical, hematological, radiological, and pathological findings in two cases of lymphatic leukemia in children have been presented. In such cases clinical findings may be indefinite, suggesting rheumatic fever, infectious mononucleosis, multiple myeloma, typhoid or paratyphoid fever, brucellosis, and other diseases rather than leukemia. The peripheral blood picture may be misleading. The persistence of "bone pain" unrelieved by salicylate therapy calls for roentgen studies of the skeleton. Roentgen evidence of bone changes in leukemia may be variable and non-specific, but signs of bone destruction, expansion of the marrow cavity, atrophy of the cortex, demineralization, and periosteal elevation with new bone formation parallel to the shaft, particularly when present along extensive areas of several long bones, should suggest the possibility of leukemia. Evidence in smears of material from sternal marrow puncture indicative of leukemia will make the diagnosis quite certain in spite of negative peripheral blood stream findings. It is only by correlation of all our knowledge to establish earlier diagnosis that progress can be made in the study of this fatal disease with the hope of finding a cure.

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leural effusion with pneumothorax	20	0 87
neumothorax	21	0 92
trapulmonary calcium deposit	17	0 74
fibrous strand	15	0 66
rank atelectasis	11	0 47
unclassified pulmonary lesion	10	0 44
ancer (?)	3	0 13
ulmonary cyst (?)	1	0 04
lung abscess (?)	1	0 04
zygoslobe anomaly	2	0 08
marked pleural thickening	28	1 2
leural adhesion	23	1 0
leural calcification	6	0 26
ventration of the diaphragm	3	0 13
eafing of the diaphragm	1	0 04
ractured rib	57	2 5
foreign body	18	0 79
coliosis of the thoracic spine	15	0 66
rib defect	10	0 44
thoracic cage deformity	1	0 04
ubcutaneous emphysema	2	0 08
rib anomaly	2	0 08
enlarged or prominent heart	269	11 8
ulmonary hypervascularity	140	6 1
marked passive congestion	8	0 35
cardiac displacement or distortion	30	1 3
Dilatation of the aorta	36	1 5
Aortic calcification	2	0 08
Unsatisfactory film	6	0 26

\* NOTE Many of the patients had multiple lesions, accounting for the discrepancies of the percentages and number of pathologic processes as compared with the total number of patients

Of the 626 definite cases of active tuberculosis, 324, or 51.7 per cent, showed bilateral involvement

Of the 365 cases of undiagnosed pneumonic densities and peribronchial infiltrations (pneumonitis), bilateral involvement was found in 61, or 17.0 per cent of the two groups

#### COMMENT

Nearly all the nationalities of Europe are represented in this series of roentgen studies, with a predominance of Poles, Russians, French, Yugoslavs, and Czechs. There were 116 females, 2,143 males, and 8 infants, the ages varying from a few weeks to 72 years. The average age was between 30 and 40.

The fact that a typhus epidemic was

present tended to overshadow the entity of tuberculosis. Of the patients examined, 626 (27.54 per cent) showed roentgenologic features of active pulmonary tuberculosis ranging from minimal to far-advanced invasion. An additional 51 persons (2.2 per cent) had suspicious evidence of the disease. Twelve patients (0.52 per cent) of the 626 had a pneumothorax on one side and active tuberculosis on the other, while 5 cases (0.22 per cent) were of miliary distribution. Approximately half of those with active lesions (51.7 per cent) showed bilateral involvement.

The tuberculosis seen was of a fulminating character, with relatively few cases of minimal involvement, as indicated by the small number of reported suspicious or minimal lesions. The great predominance of moderate and far-advanced cases with bilateral involvement is evidence of the rapid progressiveness of the pathological process. At autopsies, the pulmonary tissues were found to be riddled with tuberculous lesions in every stage, from the early exudative phase to extensive necrosis and cavitation. The fibrophthisical stage was rarely seen, due to the rapid development of the overwhelming disease. Unquestionably, the high incidence of tuberculosis was due chiefly to malnutrition supplemented by overcrowding. One can well appreciate, with an incidence as high as 27.54 per cent among hospitalized patients, how large must have been the number of those with active tuberculous lesions, unhospitalized and unexamined, who were released for return to their homes in spite of warnings as to the prevalence of the disease.

There can be little doubt that a large number of the cases designated as "undiagnosed pneumonic densities" and "peribronchial infiltrations (pneumonitis)" were of tuberculous etiology. The high percentage of bilateral involvement in these two categories is an additional indication of the specificity of the lesion in view of the findings in the series definitely diagnosed as active tuberculosis. The differentia-

# A Radiographic Chest Survey of Patients from the Dachau Concentration Camp<sup>1</sup>

ARNOLD D PIATT, M.D.<sup>2</sup>

Newark, Ohio

IN VIEW OF THE tremendous publicity given the "horror" concentration camps of Germany, it was felt worth while to present an account of routine radiographic chest examinations made of patients admitted to one of two evacuation hospitals functioning as station hospitals in the Dachau Camp

A brief explanation of the conditions, difficulties, and problems which were encountered by the medical unit to which the writer was attached seems warranted. The first echelon entered the concentration camp approximately ninety hours after the infantry units had taken over the area. A typhus epidemic was prevalent at the time of arrival. The interiors of buildings were shambles, with liberated displaced persons roaming around, looting, searching for food and for any of their Nazi captors. Approximately thirty-five thousand individuals were crowded into quarters designed to accommodate eight thousand. Small-arms fire could still be heard in certain areas of the camp. The filthy and abominable conditions within the area of concentration have been amply described by others. The task of cleaning out vermin-infested barracks outside the central compound for hospital purposes was an enormous one, while the obtaining of sufficient beds, sundry equipment, and material was a serious problem. Patients were admitted, however, the day after the arrival of the unit in Dachau. In the meantime, the tempers of the prisoners in the central compound were on "trigger edge" because of the delay in their release and the curtailment of dietary allowances due to their lowered tolerance to food. The hospital within the compound was con-

gested beyond description, and tribute must be paid to the prisoner physicians who, under overwhelming odds, accomplished miracles in the face of inadequate facilities.

Patients were taken to the Receiving and Evacuation Section of the hospital and were admitted and deloused. They were then taken to the adjoining X-ray Department, and a routine chest film was made. The patients were then moved to their respective wards. Most of the initial patients were in extremely poor physical condition and some were moribund. Those seen later were considerably better.

Following is a statistical compilation of the x-ray findings in the initial roentgenograms of 2,267 patients. Language difficulties and lack of any reliable diagnosis, history, or physical examination made interpretation hazardous, and account for the large number of undiagnosed pathological processes. The obvious cases were reported as such.

## *Statistical Analysis of 2,267 Chest Roentgenograms<sup>1</sup>*

	Patients	Per Cent
Normal	1,028	45.3
Minimal tuberculosis	143	6.3
Moderately advanced tuberculosis	225	9.9
Far-advanced tuberculosis	241	10.6
Tuberculosis with pneumothorax	12	0.52
Miliary tuberculosis	5	0.22
Suspicious	51	2.2
Pneumonia (proved)	2	0.08
Undiagnosed pneumonic density	244	10.7
Peribronchial infiltration (pneumonitis)	121	5.3
Unusual hilar thickening	65	2.8
Hilar adenopathy	20	0.87
Pleural effusion	94	4.1

<sup>1</sup> Accepted for publication in December 1945.

<sup>2</sup> Formerly on active duty with the rank of Captain in the Medical Corps of the Army of the United States.



not be demonstrated because of the collapse. The opposite lung in these cases was free from disease.

Other significant pulmonary findings were intrapulmonary calcium deposits in 17 cases (0.74 per cent), fibrous strands in 15 (0.66 per cent), frank atelectasis with the classical roentgen features of this condition in 11 (0.47 per cent), unclassified pulmonary lesions in 10 (0.44 per cent), suspected cancer in 3 (0.13 per cent). There was thought to be a pulmonary cyst in one patient and a lung abscess in another, each comprising 0.04 per cent of the entire number of cases. Only two azygos lobe anomalies were noted.

Pleural lesions were common, with marked pleural thickening present in 28 cases (1.2 per cent) and pleural adhesions in 23 (1.0 per cent). Calcifications of the pleura were observed 6 times (0.26 per cent). Eventration of the diaphragm was seen in 3 radiographs (0.13 per cent) and leafing of the diaphragm in one (0.04 per cent).

An observation of interest was the number of fractured ribs. Fifty-seven patients (2.5 per cent) had rib fractures, most of them multiple. All were recent and in various stages of healing. At first it was believed that these might be the result of a general systemic decalcification following a starvation diet but, on questioning, trauma was found to be the causative factor. Foreign bodies in the thoracic cage were discovered in 18 cases (0.79 per cent), chiefly metallic bullet fragments. Rib defects of a surgical nature were observed in 9 patients and 1 patient had destruction of a rib apparently due to a malignant tumor, bringing the total to 10, or 0.44 per cent of the entire series. Marked scolioses of the thoracic spine (0.66 per cent) were seen, and one instance (0.04 per cent) of severe deformity of the thoracolumbar spine and thoracic cage (Figs 1 and 2). Two patients (0.08 per cent) had unusual rib anomalies, and 2 had subcutaneous emphysema of the thoracic wall.

An evaluation of the cardiac and aortic



Fig 3 The large cavities and bronchopneumonic areas of tuberculous character are typical of the findings in the cases observed at the Dachau Concentration Camp. A small heart shadow, as shown here, was found in the majority of patients with tuberculosis.

findings is difficult. The heart shadow was enlarged in the transverse diameter in 269 persons (11.8 per cent), as determined by the cardiothoracic ratio. While the fact that this ratio shows a large percentage of error was taken into consideration, nevertheless, any case showing a cardiothoracic index appreciably higher than average was placed in the enlarged or prominent heart category. Many of these patients showed concomitant hyper-vascularity in the hilar regions, a phenomenon which was discerned in 140 films (6.1 per cent). Intensive passive congestion involving the hili and the bases of both lungs was seen in 8 instances (0.35 per cent). A surprising number of prominent hearts were found in persons with moderately and far-advanced tuberculosis, although by far the larger number of cardiac shadows in tuberculous patients were quite small, an observation confirmed in numer-



Figs 1 and 2 The rounded density seen in Fig 1 contiguous with the cardiac shadow on the right was puzzling. A roentgenogram of the dorsal spine (Fig 2) solved the problem, showing a severe scoliosis, apparently of developmental character. The integrity of the bodies of the vertebrae was well maintained except for flattening on the concave side. The intervertebral spaces were not appreciably narrowed.

tion between the undiagnosed pneumonic densities and peribronchial infiltrations (pneumonitis) was solely on a physical basis. Any consolidation or infiltration of bronchopneumonic character of any extent was placed in the former group, while any pathologic increase in the pulmonary peribronchial markings was included in the latter. A great number of the lesions in these two groups were basal in location and could well have been the so-called "basal" or "lower-lung-field" tuberculosis, which has lately received so much attention. Two hundred and forty-six patients (10.78 per cent) had pneumonic densities and 121 (5.3 per cent) displayed peribronchial infiltration, of the combined groups, 61 (1.7 per cent) had bilateral disease. In 2 instances (0.08 per cent) the pneumonic densities later proved clinically to be pneumonia.

"Unusual hilar thickening" was the designation applied to a group of pathological findings which exaggerated, distorted, or completely erased the usual

butterfly appearance of the hilus. Sixty-five roentgenograms presented this picture, making 2.8 per cent of the entire series. There were 20 patients (0.87 per cent) in whom hilar adenopathy could be clearly discerned radiographically. Though no definite causative factor could be ascertained at the time, one could feel reasonably sure that tuberculosis contributed its share to these two categories.

Pleural effusion of varying degree was demonstrated in 114 patients (4.97 per cent), 20 of whom (0.87 per cent of the entire series) had a concomitant pneumothorax. Since tuberculosis is one of the most common offenders in this pleural response, the incidence of that disease in our series must be notably higher than appears from the actual figures.

Twenty-one roentgenograms (0.93 per cent) showed unilateral pneumothorax and no other demonstrable disease. In most instances the pneumothorax had been artificially induced for the treatment of tuberculosis, but the primary lesion could

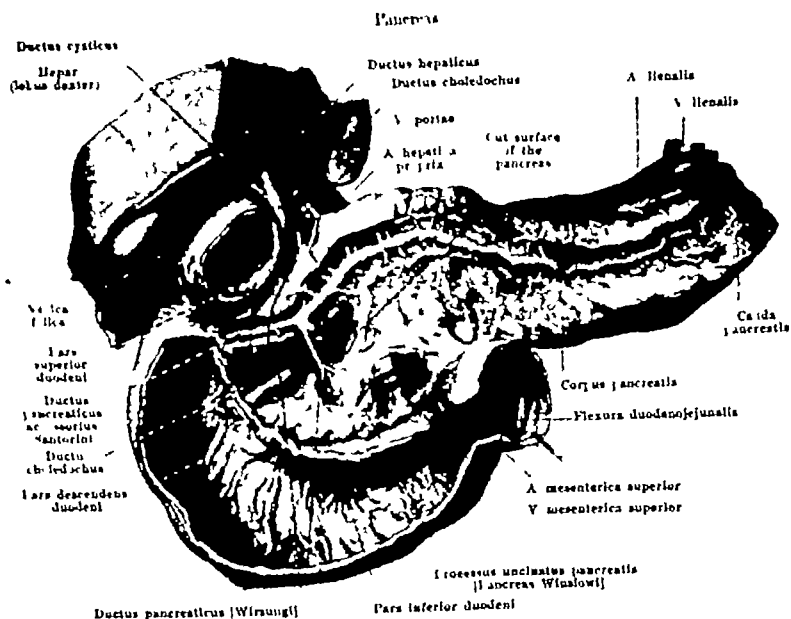
# A New Roentgen Sign in Extrahepatic Biliary Tract Disease<sup>1</sup>

SAMUEL BROWN, M D, F A C R., and FOREST G HARPER, M D

Cincinnati, Ohio

IN PREVIOUS publications (1, 2), attention was called to a pressure defect frequently observed in the contour of the superior flexure of the duodenum due to diseases of the extrahepatic biliary tract. Since then, the value of this observation has been enhanced by the accurate diag-

This roentgen sign depends basically upon the intimate anatomical relationship existing between the duodenum and the neighboring structures and their action upon one another. An analysis of the accompanying illustration from Spalteholz's *Anatomy* will make the above state-



Drawing reproduced from Spalteholz's *Anatomy* showing the intimate relationship between the duodenum and its neighboring structures—the gallbladder, cystic, hepatic and common ducts, liver, pancreas, and right kidney

nosis of many more cases which were not solved by the usual x-ray technic. The pressure defect has also proved useful in the differential diagnosis between obstructive and non-obstructive jaundice, being present in the former but seldom in the latter. In view of the fact that it is generally recognized that the differentiation of obstructive from non-obstructive jaundice is often very difficult, in spite of all the known tests, the roentgen sign assumes an added importance.

It is seen that the segment of the duodenum comprising the superior flexure is surrounded by the neck of the gallbladder on the right side, the cystic and hepatic ducts above, and the common duct on the left. These tubular structures resemble a clamp whose open ends are directed downward toward the head of the pancreas, forming an almost closed ring which practically encircles the duodenum. It is, furthermore, reinforced by the solid structures of the

<sup>1</sup> Read by title at the Thirty first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.



Fig 4 A prominent cardiac silhouette was noted in a considerable number of tuberculous patients, resembling the "beriberi heart." Note the presence of advanced tuberculosis

ous autopsies (Fig 3). It is to be wondered if the prominent hearts, both in the non-tuberculous and tuberculous, may not have represented hypertrophy or transient dilatation due to an avitaminosis, as in beriberi. The configuration of a great number resembled the so-called "beriberi" type of heart with both right and left ventricular preponderance (Fig 4). Clinically however, none of the neuropathic manifestations of beriberi were present.

Cardiac displacement or distortion was seen in 30 patients (1.3 per cent), due either to massive pleural effusion or fibrous band retraction of the mediastinal structures.

Dilatation of the aorta was evident in 36

cases (1.5 per cent) and was designated as such when the measurements exceeded the upper limit of normal. To what extent hypertensive heart disease or syphilis played a part could not be ascertained. Calcifications in the aorta were seen in 2 roentgenograms (0.08 per cent), this small number can be attributed to the average age of the patients.

Six roentgenograms (0.26 per cent) were unsatisfactory and could not be repeated due to the shifting of patients among the wards and their transfer out of the unit hospital.

#### SUMMARY

- 1 A high percentage of active tuberculosis (27.54 per cent) was demonstrated radiographically in 2,267 patients from the Dachau Concentration Camp.

- 2 A large number of undiagnosed pneumonic densities, peribronchial infiltrations (pneumonitis), pleural effusions, and pneumothoraces were no doubt of tuberculous etiology, increasing the incidence above that actually shown.

- 3 Prominent hearts were observed in a considerable number of moderately and far-advanced cases of tuberculosis, and it is felt that avitaminosis may have played a large part as the causative agent.

- 4 The incidence of tuberculosis in Europe will unquestionably be greatly increased in the next ten years due to the return from concentration camps of displaced persons with undiagnosed active disease, as well as a universally insufficient diet and overcrowding in large cities.

NOTE An expression of thanks and appreciation is hereby extended to Colonel Aubrey L. Bradford for his helpful suggestions and constructive criticism in the preparation of this paper.

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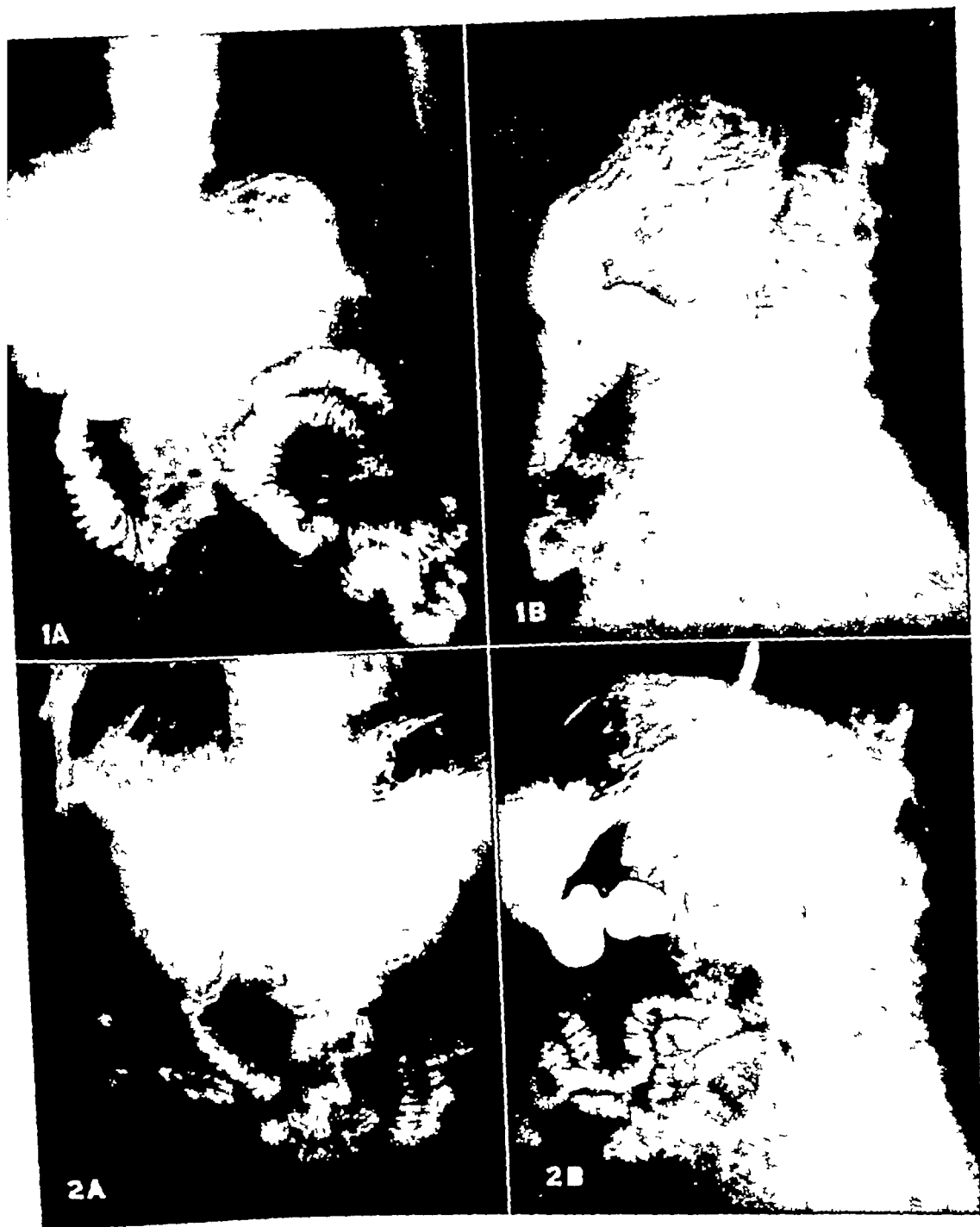


Fig 1 Case 1 A Anterior view, showing stomach and duodenum in normal position and of normal shape and contour A gallstone shadow indicates the position of the gallbladder  
 B Lateral view Note the anterior position of the stomach and the posterior position of the duodenum The gallstone is between the inferior surface of the liver and duodnal bulb, in front of the spine  
 Fig 2 Case 2 A Anterior view The stomach occupies a normal position The bulb shows a pressure defect due to an enlarged gallbladder with stone  
 B Lateral view The superior flexure of the duodenum is narrow and elongated, due to pressure of the enlarged gallbladder and stone

liver and the pancreas above and below

This ring-like tubular system is not a rigid structure but is more or less elastic and capable of some degree of expansion, depending upon the quantity of bile contained, which varies from time to time depending upon the physiological activity of the biliary system and the state of the sphincter of Oddi. When the ducts are in a state of dilatation, they undoubtedly exert some pressure upon the enclosed fixed duodenal segment. This may explain the so-called spasm frequently observed in this region, preventing the barium mixture from leaving the duodenal bulb. It is perhaps possible that the sphincter-like action of the biliary tubes upon the duodenum is physiological in nature and exercises some control over the rate of the passage of food. Be that as it may, under pathological conditions, the dilated ducts exert pressure upon the duodenum, often resulting in dilatation of the duodenal bulb and at times causing partial obstruction.

Duodenal changes which may occur as a result of pressure are seldom shown roentgenologically in the usual anterior view of the stomach, since the duodenum does not lie in the same plane. Its course is backward, downward, and then forward, describing a semicircle around the head of the pancreas. It is evident, therefore, that its true course and the exact location of its parts can be seen only in profile. The right lateral decubitus position has been found to be the most satisfactory in demonstrating the entire configuration of the duodenal loop. Most alterations in position, shape, and contour, as a result of intrinsic and extrinsic changes, are recognizable in this view.

Several representative cases have been chosen from a large series illustrating various abnormal extrahepatic biliary tract conditions which may be recognized as a result of the pressure defect of the superior flexure of the duodenum upon examination in the right lateral decubitus position.

*Case 1* This case was chosen for the purpose of demonstrating the average

normal position of the stomach and duodenum and their relationship to the neighboring structures as shown in the anterior and right lateral decubitus position. The stomach and duodenum occupy a normal position (Fig 1, A). To the right of the pylorus and duodenal bulb is a dense shadow due to a gallstone, indicating the position of the gallbladder. All these structures appear to be in the same plane, but from our knowledge of regional anatomy we know that this is not true. An analysis of the right lateral view (Fig 1, B) shows that the stomach is located anteriorly in the abdominal cavity with the pylorus just behind it. The duodenal bulb is sitting on top of the pyloric sphincter, and its continuation extends backward under the inferior surface of the liver. When it reaches the right kidney, it angulates downward, this descending portion, together with the ascending portion, forms a loop surrounding the head of the pancreas. The gallstone, which represents the position of the gallbladder, lies deep in the abdomen and is adjacent to the bulb beneath the inferior surface of the liver. It will be evident that the right lateral view gives a more accurate conception of the exact location of the several structures than does the anterior view.

*Case 2* In a patient with a history of gallbladder disease the stomach and duodenum occupy a normal position in the ventral view. The duodenal bulb is somewhat compressed by a soft mass containing a large gallstone (Fig 2, A). In the right lateral position the segment of the superior flexure of the duodenum is seen to be elongated and narrowed as a result of pressure by the gallstone (Fig 2, B). Since the neck of the gallbladder is in relation to the duodenal angle, the stone evidently lies in the neck, causing obstruction with dilatation of the gallbladder. This observation was confirmed by operation.

*Case 3* The history in this case was strongly suggestive of gallbladder disease. The dye test failed to demonstrate the gallbladder and no dense shadows of stones

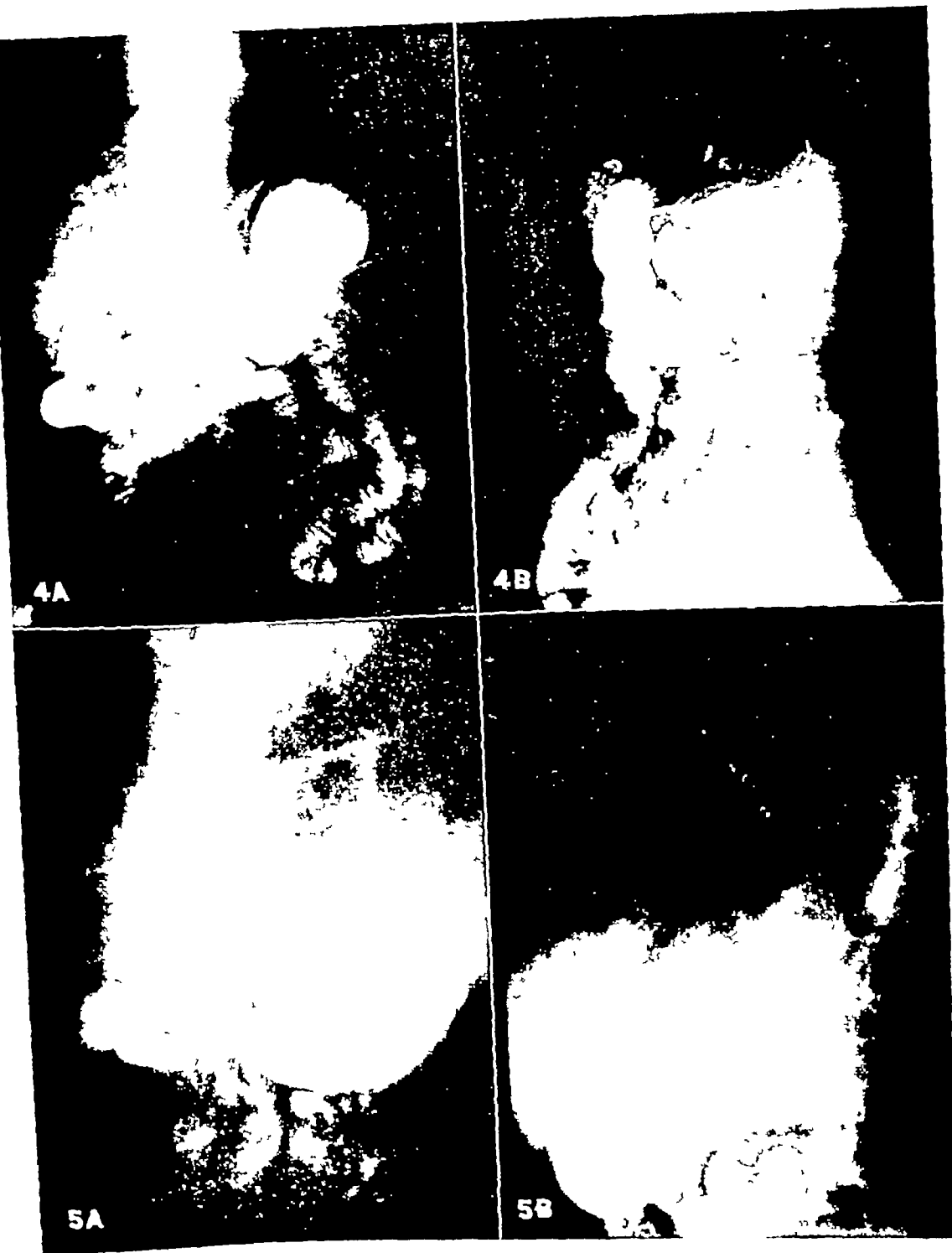


Fig. 1 Case 4 A Anterior view The stomach and duodenum are displaced to the right, apparently due to adhesions following a previous operation on the gallbladder  
 B Lateral view showing pressure defect of the superior flexure due to a dilated common duct with stones  
 Fig. 5 Case 5 A Anterior view, showing stomach and duodenum in normal position and of normal shape and size in a patient with intermittent jaundice  
 B Lateral view showing pressure defect in contour of the superior duodenal flexure, due to a dilated common duct with stones



Fig 3 Case 3 A Anterior view, showing stomach and duodenum in normal position and of normal shape and contour

B Lateral view, showing pressure defect in contour of the superior flexure of the duodenum due to a stone in the gallbladder not demonstrable by the Graham test

were seen on the plain view. Examination of the stomach and duodenum in the ventral position showed no abnormal changes in contour or position (Fig 3, A). In the right lateral position, the duodenum showed a pressure defect at the superior flexure (Fig 3, B). Since there was no jaundice, the pressure defect was assumed to be due to dilatation of the neck of the gallbladder, probably as a result of a stone. This was confirmed by operation.

**Case 4** A woman of 75 had had her gallbladder removed because of stones twenty years previously. During the past few years she was often troubled with pain in the epigastrium. There was no jaundice. Several x-ray examinations were done without a definite diagnosis. During the last examination, particular attention was paid to the right lateral view. In the anterior position the pylorus and duodenum were slightly displaced to the right, which was assumed to be due to

adhesions (Fig 4, A). In the right lateral position a pressure defect was noted at the superior angle of the duodenum (Fig 4, B). This was interpreted as being due to a dilated common duct, notwithstanding the absence of jaundice. With this positive finding the surgeons no longer hesitated to operate, and a dilated common duct was found, containing several stones.

**Case 5** This patient complained of pain in the epigastrium with intermittent jaundice suggestive of a stone in the common duct. The gallbladder could not be demonstrated by cholecystography. Examination of the stomach and duodenum in the anterior position revealed nothing unusual (Fig 5, A). In the right lateral position, however, a constant pressure defect was observed in the region of the superior angle (Fig 5, B). A dilated common duct with stones was held responsible for the pressure defect, and this opinion was confirmed by operation.



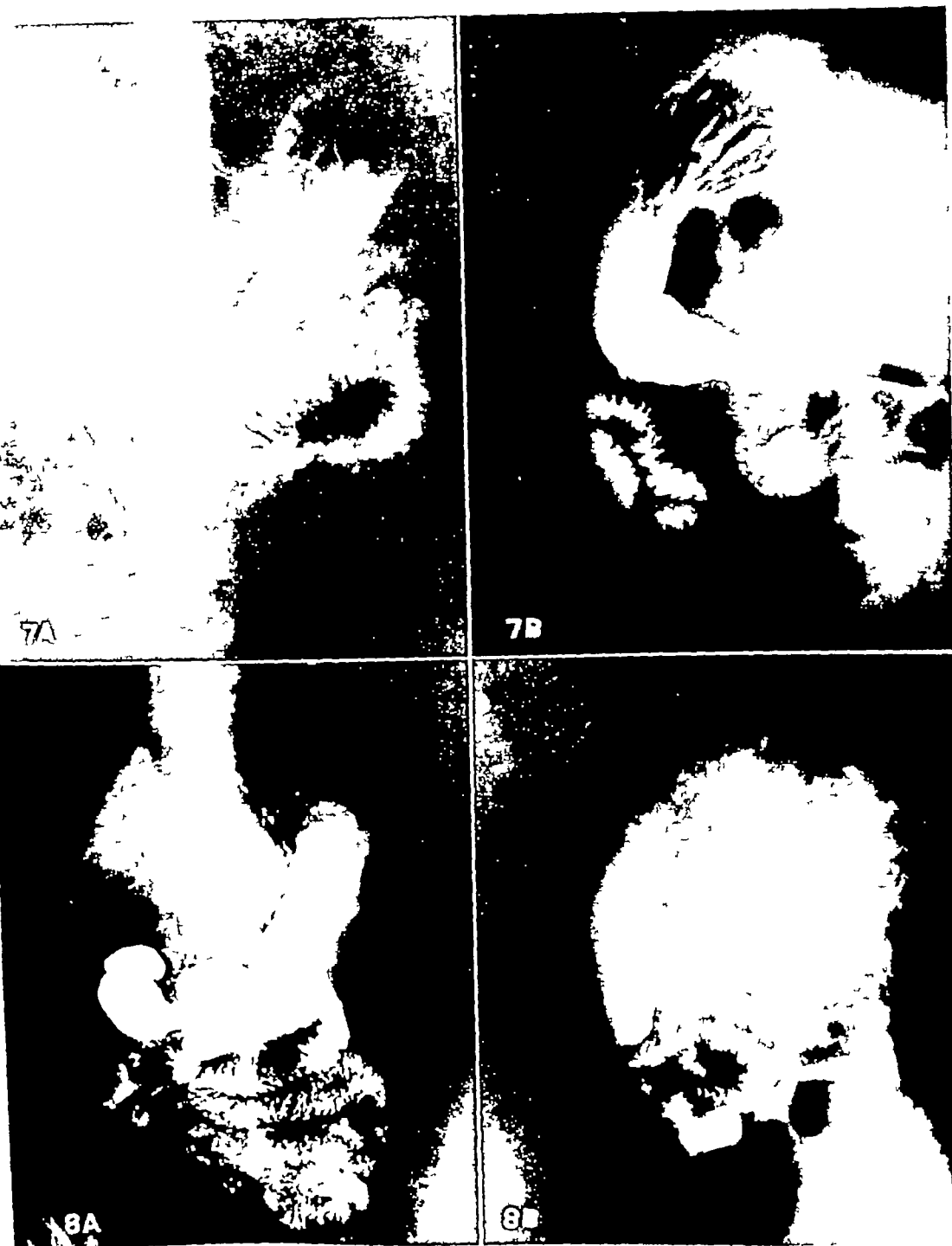


Fig 7 Case 7 A Anterior view, showing stomach and duodenum in normal position, and of normal shape and contour in a patient with a moderate degree of jaundice  
 B Lateral view revealing a constant pressure defect in the region of the superior flexure, proved to be due to a tumor of the hepatic duct and an enlarged gallbladder  
 Fig 8 Case 8 A Anterior view, showing normal position, shape, and contour of the stomach and duodenum in a patient with a moderate degree of jaundice  
 B Lateral view The elongation and narrowing of the superior flexure proved to be due to a tumor arising from the hepatic duct and an enlarged gallbladder

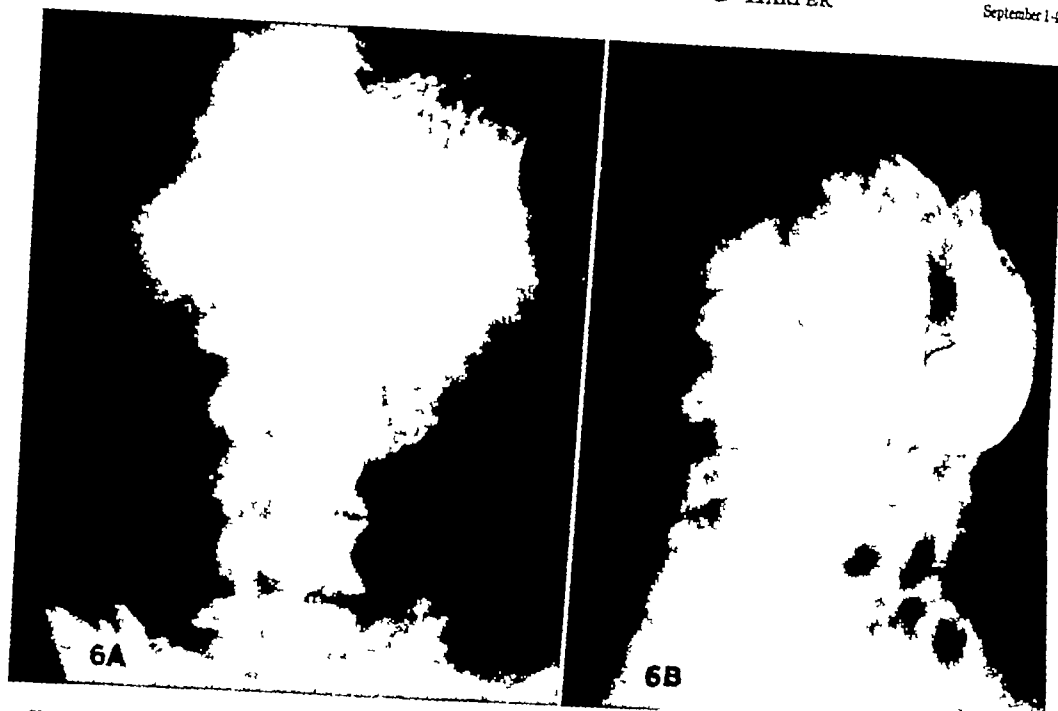


Fig 6 Case 6 A Anterior view The stomach and duodenum are displaced to the left, in a patient with progressive painless jaundice  
B Lateral view, demonstrating constant pressure defect of superior flexure due to dilatation of common duct as a result of a tumor and enlarged gallbladder

*Case 6* This patient was troubled with progressive painless jaundice strongly suggestive of a new growth in the common duct. In order to obtain more or less direct roentgen evidence of the disease, the stomach and duodenum were studied and were found to be normal except for slight displacement to the left (Fig 6, A). In the right lateral position a constant pressure defect was observed at the superior flexure of the duodenum, which indicated a dilated duct as a result of an obstruction, probably due to a new growth in the duct but not to a tumor of the head of the pancreas, since the duodenal loop was not enlarged (Fig 6, B). The diagnosis of a new growth of the common duct and a dilated gallbladder was confirmed by operation.

*Case 7* A male patient had progressive painless jaundice of a moderate degree. The question of obstructive or non-obstructive jaundice could not be determined by clinical tests. X-ray examination of the stomach and duodenum revealed nothing

abnormal in the anterior view (Fig 7, A). In the right lateral view (Fig 7, B) a constant pressure defect was seen in the region of the superior angle, indicating dilatation of the biliary ducts. Since the duodenal loop was not enlarged, a tumor of the head of the pancreas was excluded and a diagnosis of a tumor of the extrahepatic biliary ducts was made. The tumor originated in the hepatic duct, as shown by operation and postmortem examination.

*Case 8* This patient showed a moderate degree of jaundice, the origin of which was uncertain. An anterior view of the stomach showed it to be in normal position and of normal size and shape (Fig 8, A). In the right lateral position, elongation and narrowing of the superior flexure were observed (Fig 8, B). This finding definitely indicated that one of the adjacent structures was enlarged and was responsible for the pressure defect. Operation disclosed a tumor originating from the cystic duct. There was a resultant distention of the gallbladder.



Fig 10 Case 10 A Anterior view, showing displacement of the stomach and duodenum to the left. The barium is displaced from the pylorus as a result of pressure from a palpable mass. The patient had progressive jaundice.

B Lateral view. The superior flexure is narrow and elongated and the duodenal loop is enlarged. A diagnosis of pancreatic tumor with dilated common duct and enlarged gallbladder was confirmed at operation.

Fig 11 Case 11 A Anterior view. The stomach and duodenal bulb are moderately dilated. There is displacement of the barium from the pylorus as a result of pressure by a palpable mass. A pressure defect is seen at the superior flexure.

B Lateral view showing stricture at the superior flexure, delaying the passage of barium. A diagnosis of pancreatic tumor with dilatation of the common duct was confirmed at operation.



Fig 9 Case 9 A Anterior view, showing stomach and duodenum in normal position, and normal in shape and contour, in a patient with slight jaundice  
B Lateral view, showing narrowing and elongation of the superior flexure due to pressure from a tumor originating from the under surface of the liver

**Case 9** This patient presented a slight degree of jaundice of undetermined origin. An anterior roentgenogram showed the stomach and duodenum in normal position and of normal shape and size (Fig 9, A). In the right lateral position the superior flexure was found to be narrowed (Fig 9, B). The diagnosis of a tumor in the vicinity of the duodenal angle was confirmed by operation. The tumor originated from the under surface of the liver and was proved to be of metastatic origin.

**Case 10** A patient who suffered from a severe degree of jaundice had a palpable mass in the region of the pylorus. X-ray examination showed displacement of the stomach and duodenum to the left (Fig 10, A). The mass was in front of the spine and displaced the barium meal from the pyloric end. In the right lateral position the duodenal loop was found to be moderately enlarged. The superior duodenal flexure was narrow and elongated

(Fig 10, B). The diagnosis of enlarged gallbladder and a tumor of the head of the pancreas causing dilatation of the common duct was confirmed by operation.

**Case 11** An elderly woman presenting progressive jaundice had a rather large dilated stomach and duodenal bulb, with a stricture beyond, in the region of the superior angle, resulting in a partial obstruction (Fig 11, A). This case is one of the very few which showed the stricture in the anterior view. There was also a pressure defect in the region of the pylorus which corresponded to a mass palpable on abdominal examination. In the lateral view the bulb was seen to be moderately dilated and the stricture was again shown to be in the region of the superior duodenal flexure (Fig 11, B). The diagnosis of a dilated duct, probably as a result of a tumor of the head of the pancreas, was confirmed by operation.

**Case 12** This patient presented a pal

# A Radiographic Study of Spondylolisthesis with Special Reference to Stability Determination<sup>1</sup>

MAJ ISADORE MESCHAN, M.C., A U S

IN A PAPER published elsewhere (1), an improved method for the detection of spondylolisthesis has been described, as well as a method of determining the degree of stability or instability of the slipped vertebral body. These methods are briefly reviewed here in the light of more extensive experience gained with additional cases subsequently seen.

## ANATOMICAL CONSIDERATIONS

The term "pars interarticularis" is a descriptive one, but has caused some confusion because it does not appear in most classical texts. It refers to the isthmus of bone lying between the superior and inferior articular processes. Actually, this segment is a portion of the lamina and separates the vertebral body, pedicles, superior articular processes, and transverse processes on the one hand, from the inferior articular processes and spinous process on the other. This is illustrated in Figure 1, in which the pars interarticularis is indicated by wire on both the photograph of a lumbar vertebral body and on roentgenograms in the anteroposterior, lateral, and oblique positions. A superior-inferior view is also shown, but this projection, of course, is not applicable clinically. The oblique projection has been found to be the most accurate, and will reveal a defect even when other views fail to do so. Oblique views of the lumbosacral spine are employed routinely in all examinations of this region. A labeled diagram of a representative oblique view of the lumbosacral spine is shown in Figure 2 with an accompanying roentgenogram.

The defects can also occasionally be seen on the anteroposterior projection, when bilateral, they can usually be detected in straight lateral views.

Normally, the vertebral body is pre-

vented from anteroposterior displacement by paraspinous ligaments, muscles, and the superior and inferior apophyseal joints. The superior joints prevent posterior displacement, the inferior prevent anterior displacement. If the function of the inferior intervertebral (apophyseal) joints is faulty, the other supporting structures may not be adequate to prevent anterior displacement of the vertebral body. Thus, in case of a bilateral defect in the pars interarticularis of a vertebra, the vertebral body becomes susceptible to anterior displacement.

The mechanism of spondylolisthesis becomes readily apparent when one considers that, in cases of bilateral defects of the pars interarticularis, the vertebral body is held securely superiorly but not inferiorly. With sufficient stress, the vertebral body will swing forward about the superior fixed points in the arc of a circle (Fig 3), and the lower margin of the vertebral body will move through a greater space than the upper margin. With sufficient strain upon the capsule of the superior apophyseal joint, it will stretch and allow a small amount of anteroposterior motion and, in these rarer instances, the superior and inferior surfaces of the slipped vertebral body will move through equivalent spaces. The vertebral body may move forward without any movement of the separated neural arch, and it is a mistake to expect to palpate an indentation of the spinal column clinically, where the spondylolisthesis has occurred. A looseness of the neural arch may, however, be palpated. Actually, in many of the more advanced cases, the spinous process of the slipped vertebral body is more prominent than normal because it is no longer anchored inferiorly, and it may be displaced posteriorly just as the vertebral body moves anteriorly.

As the result of these anatomical con-

<sup>1</sup> Accepted for publication in October 1945.



Fig 12 Case 12 A Anterior view, showing stomach and duodenum displaced to left  
 B Lateral view, showing pressure defect at the superior angle, proved to be due to a tumor arising from the right lobe of the liver in the vicinity of the duodenal flexure

pable tumor in the right lumbar region. In the anterior view (Fig 12, A) the stomach and duodenum were displaced to the left. In the right lateral view (Fig 12, B) the stomach was neither displaced forward or backward, which excludes an enlarged liver or kidney but suggests a large gallbladder. The presence of a pressure defect at the superior flexure made this supposition stronger, but upon operation a tumor of the right lobe of the liver, in the vicinity of the duodenum, was found to be responsible for the pressure defect.

#### CONCLUSION

The new roentgen sign in extrahepatic biliary tract disease is dependent upon the intimate anatomical relationship which exists between the duodenum and adjacent structures and their action upon one another. The neck of the gallbladder and the cystic and common ducts form a tubular ring which almost encircles the superior flexure of the duodenum whose freedom of mobility is limited by the liver above, the pancreas below, and the

right kidney behind. When the tubular system is dilated because of an obstruction by a stone or a tumor within the ducts, or by an extrinsic mass in the vicinity of the duodenum, the superior flexure suffers compression. This pressure defect is demonstrable roentgenologically only in the right lateral decubitus position, for the course of the proximal portion of the duodenum is from before backward. This sign has enabled us to diagnose diseases of the gallbladder, ducts, liver, and pancreas which could not be diagnosed by the usual x-ray method. It has also enabled us to differentiate between obstructive and non-obstructive jaundice, being present in the former, but absent in the latter.

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# A Radiographic Study of Spondylolisthesis with Special Reference to Stability Determination<sup>1</sup>

MAJ ISADORE MESCHAN, M C, A U S

IN A PAPER published elsewhere (1), an improved method for the detection of spondylolisthesis has been described, as well as a method of determining the degree of stability or instability of the slipped vertebral body. These methods are briefly reviewed here in the light of more extensive experience gained with additional cases subsequently seen.

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As the result of these anatomical con-

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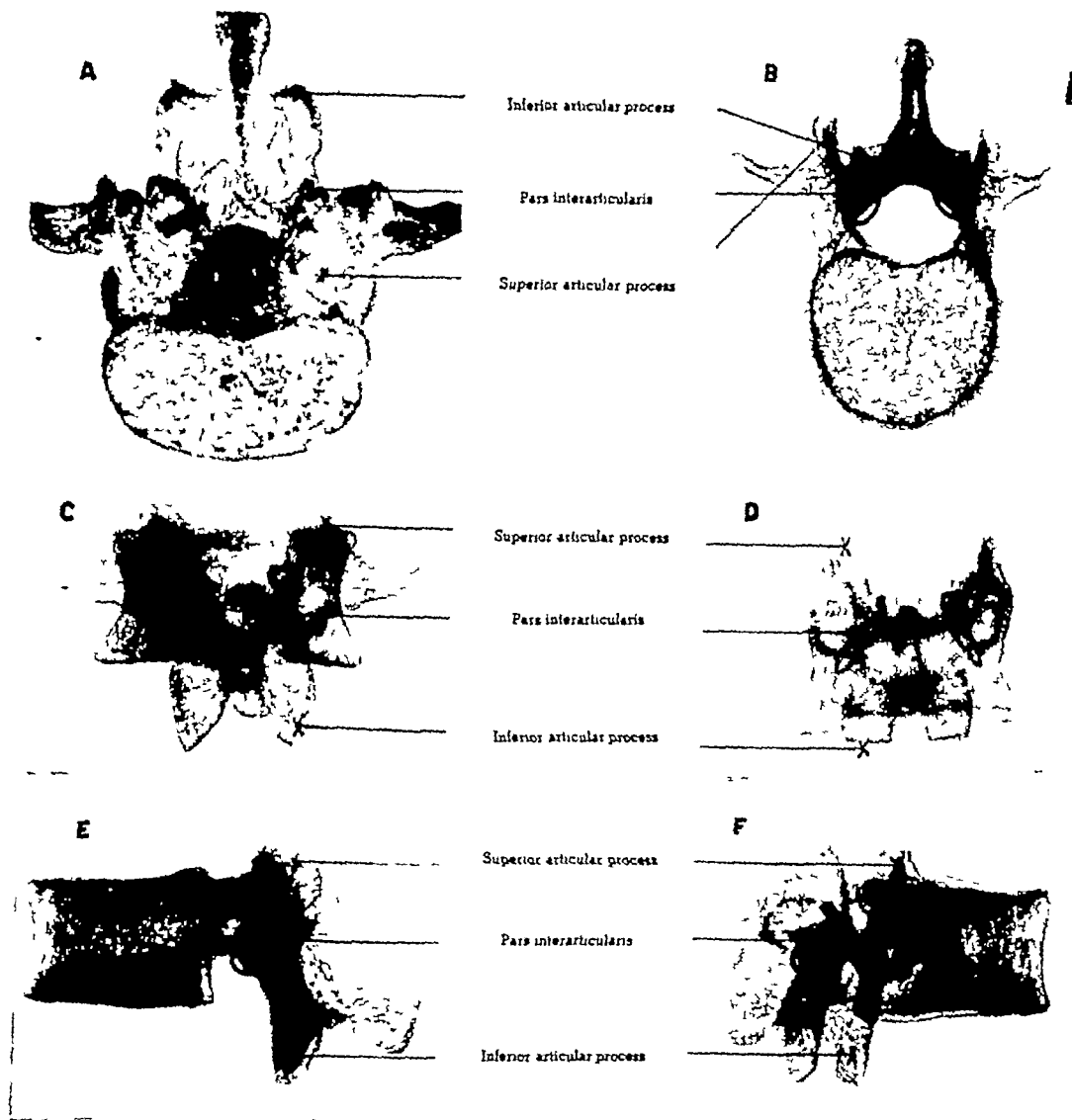


Fig 1 Photograph (A) of a lumbar vertebral body, with wire around the pars interarticularis and roentgenograms (B-F) of the same vertebral body, showing the projection of the parts interarticularis in the superior inferior, anteroposterior, oblique, and lateral views. The two anteroposterior views indicate the position of the lumbar vertebrae as the result of the normal lumbar lordosis.

siderations and this mechanism of spondylolisthesis, the posterior margin of the slipped vertebral body bears a definite relationship to the posterior margins of adjoining vertebral bodies. It is this relationship which has been used to detect and measure spondylolisthesis quite accurately, as will be described in detail.

The measurement of the degree of slipping has an important application. A slipped vertebral body may be relatively

stable and not move about with changes in position of the spine, or it may be unstable and slip forward considerably more in some positions than in others. Not only is weight-bearing to be considered in revealing instability, but also flexion and extension of the spine. Additional views under these conditions may also reveal a latent spondylolisthesis and should be routine in every case with defects of the pars interarticularis. We have not been able to



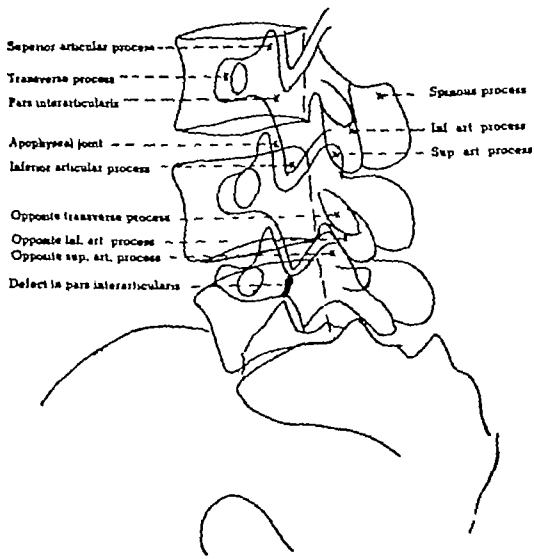


Fig 2 Oblique roentgenogram and tracing of the lumbosacral spine

demonstrate a spondylolisthesis in cases without a bilateral defect in the pars interarticularis

ETIOLOGY OF DEFECT IN THE PARS INTERARTICULARIS

We have discussed the etiology of defects of the pars interarticularis at greater length elsewhere (1) Here we need repeat

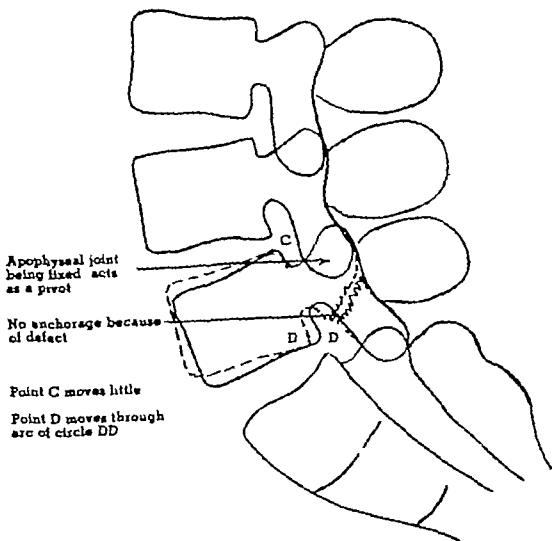


Fig 3 A diagram to illustrate the mechanism of spondylolisthesis.

only that there is considerable evidence in favor of either of two theories (1) that the condition may be the result of trauma at birth, very early in life, or even at a later age, (2) that the condition may be due to faulty ossification in the course of the development of the spine In either case trauma may be superimposed, placing additional stress on the anterior paraspinous ligaments and muscles, and spondylolisthesis may result or become aggravated This is of special significance in the determination of "line-of-duty" status of soldiers disabled by this disease

In the presence of bilateral defects of the pars interarticularis, the added stress on the paraspinous ligaments not infrequently becomes manifest by localized hipping of the vertebral body in question Evidence of arthritis of the apophyseal joint in this region is also occasionally found

METHOD OF EXAMINATION

Our routine radiographic examination of the lumbosacral spine includes recumbent anteroposterior, lateral, and both oblique views When defects of the pars interarticularis are noted, additional lateral views are taken as follows (1) with the patient standing erect (erect weight-bearing), (2) with the patient standing and

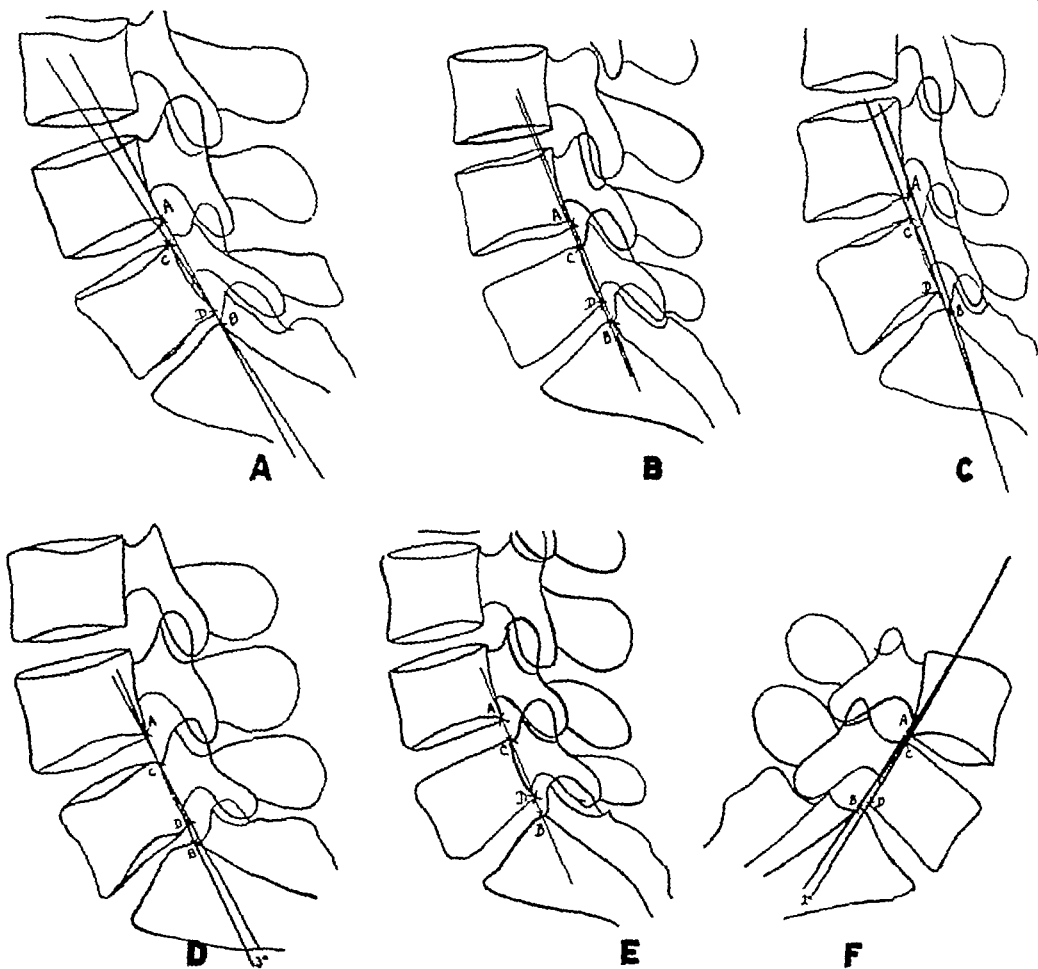


Fig 4 Tracings of normal lumbosacral spines (lateral projections only) to demonstrate the various types of normal alignment of the lumbosacral vertebrae.

A Lines intersecting at lower margin of L5 B Lines parallel, 2 mm apart. C Lines intersecting below L5 D Lines intersecting at upper level of L5, angle  $3^{\circ}$  E Lines superimposed, forming single straight line. F Recumbent neutral projection Lines intersect above L5, but angle is small, less than  $3^{\circ}$

flexing the spine, (3) with the patient standing and extending the spine

The method of detecting spondylolisthesis is as follows. The lateral projections, as shown in Figures 4 and 5, are the ones employed. Here point A is the posterior inferior lip of the vertebral body above the one in question, point B is the posterior superior lip of the vertebral body below the one in question, C is the posterior lip of the superior surface of the involved vertebral body, and D is the posterior inferior lip of the involved vertebral body. Films with sharp detail are necessary to make these points apparent with accuracy. Lines AB and CD are then drawn and ex-

tended until they intersect, if possible. Occasionally, they will be parallel, or AB will be superimposed on CD (Fig 4).

When these lines are drawn, various configurations are produced. In the normal spine the configuration of the lines falls into the various categories shown in Figure 4. When the lines intersect, they almost invariably do so at the level of, or below, the vertebral body in question. The angle thus formed is without definite significance. If the lines are parallel, they are 3 mm or less apart. Very rarely, the lines will intersect above the vertebral body in question, but the angle will not exceed 2 degrees.

The configuration of the lines in cases of

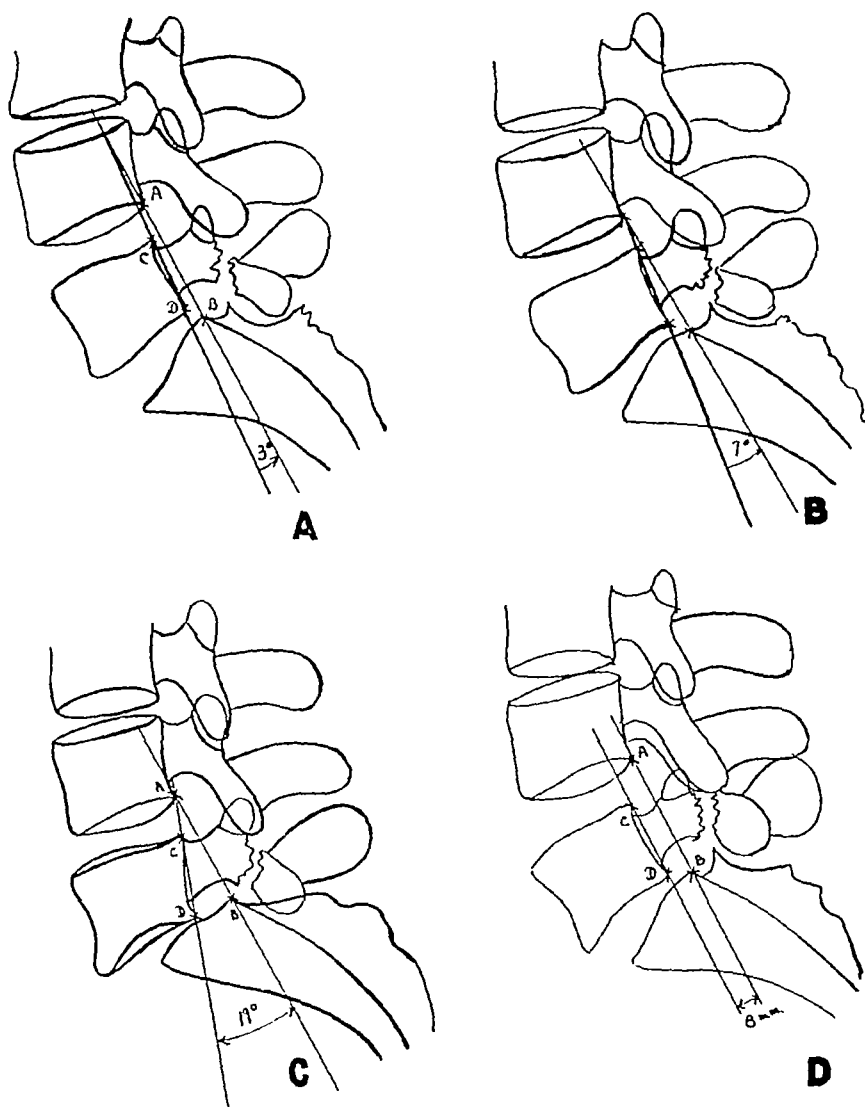


Fig 5 Tracings from cases of spondylolisthesis to demonstrate types of lateral alignment seen in this condition

A Very slight spondylolisthesis Lines intersect above L5, but the angle formed is only  $3^{\circ}$  B Slight spondylolisthesis Lines intersect above L5 C Moderately severe spondylolisthesis D Slight spondylolisthesis Lines parallel but more than 3 mm apart

spondylolisthesis (Fig 5) is different from that of spines without a slipped vertebral body. Because of the mechanism of displacement previously described, the lines intersect above the vertebral body in question. Occasionally they are parallel, but in such instances they are more than 3 mm apart. The angle formed is of definite significance, indicating the extent of forward slipping of the vertebral body. We have arbitrarily designated up to 10 de-

grees of slipping as slight, 10 to 20 degrees as moderate, and more than 20 degrees as severe. On the few occasions that the lines are parallel, we have designated up to 1 cm of slipping as slight, 1 to 2 cm as moderate, more than 2 cm as severe.

#### METHOD FOR DETECTION OF INSTABILITY OF THE SLIPPED VERTEBRAL BODY

We have considered a slipped vertebral body as being unstable if the degree of an-

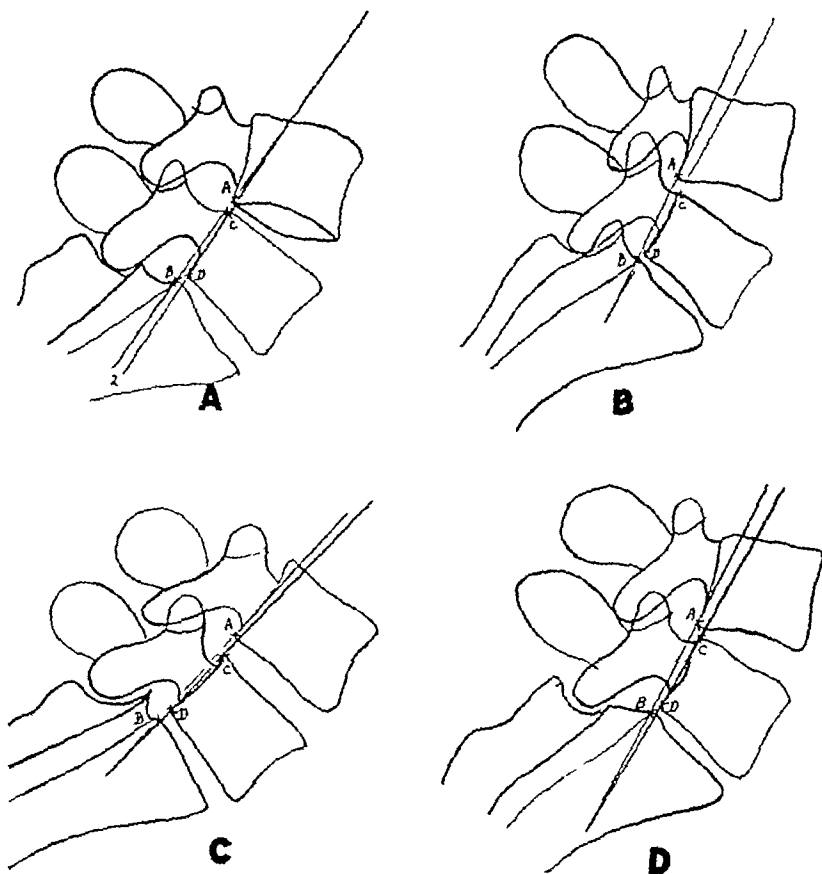


Fig 6 Tracings to show normal changes observed with weight-bearing positions  
 A Normal Recumbent neutral projection Lines intersect above L5 but angle is small less than  $3^\circ$  B Normal Weight-bearing neutral projection C Normal Weight-bearing flexion projection D Normal Weight-bearing extension projection

terior displacement changes significantly in the various positions of the spine, as determined by comparison of the measurements on the various lateral films. The degree of stability or instability is indicated by the maximum change observed in the various positions. Usually (but not invariably) the closest approach to the normal is in the flexed position, and the maximum degree of displacement is in the extended position.

When  $CD$  is parallel to  $AB$  in one of the views and forms an angle in the others, another method of measurement must be employed to make the comparison possible. In such instances, the perpendicular distances from points  $C$  and  $D$  to line  $AB$  are measured and compared on the various

views, provided the same target-film distance is employed on all views (Fig 6). This is not a frequent occurrence.

With good films, these measurements can be considered accurate to 2 mm or 2 degrees, greater variations can be considered relatively significant of instability.

#### STATISTICAL REVIEW

From April 19, 1942, to March 10, 1944, the general hospital from which this report comes was situated in the rear echelon of one of the Army theaters overseas. The statistics regarding spondylolisthesis cases from April 10, 1942, to February 1944 have been published elsewhere (1) and only brief reference will be made to these as compared with our present statistics.

TABLE I COMPARISON OF PRESENT SURVEY WITH PREVIOUS SURVEY

	Previous Study, 22 Months (Rear Echelon)	Present Study, 6 Months (Forward Echelon)
No of lumbosacral spine examinations	1131	520
No of defects of pars interarticularis	57 (5 0%)	61 (11 7%)
No of cases of spondylolisthesis or borderline spondylolisthesis	41 (3 6%)	34 (6 5%)
No of cases studied with stability tests	18 (44%)	28 (82%)
No of unstable cases	7	14
Percentage instability in cases so studied	39%	50%

Since April 26, 1944, the hospital has been functioning in a forward echelon in the same theater. The present survey concerns cases seen between that date and Oct 26, 1944, an interval of six months as compared with a previous interval of twenty-two months. Such differences as are noted are attributed to the following factors: (1) Patients are now sent to us directly from the forward areas, whereas previously many were filtered out and returned to the United States before they reached our hospital. (2) We are now situated in a tropical, humid climate, which we feel has an aggravating influence on certain types of back pain. (3) There are greater numbers of soldiers now in this theater actively involved in physically strenuous activities. (4) Our special interest in this problem has been focused in this direction in the past eighteen months. (5) Stability studies in all cases with bilateral defects of the pars interarticularis are now routine, whereas they were employed only in the latter part of the previous survey (18 cases).

On these bases, we believe that our later statistical review is more representative of the occurrence of spondylolisthesis in cases of low back pain in the Armed Forces, and we have therefore not consolidated the two series.

In the six-month interval under consideration, the number of lumbosacral spine examinations done (520) is 46 per cent of

the previous total for twenty-two months (1131) (Table I). Whereas, in the previous survey, defects of the pars interarticularis were noted in 5 per cent of the studies, in the present series the incidence is 11.7 per cent, and the actual number exceeds the previous total. The number of cases of spondylolisthesis is proportionately greater in the more recent series, 6.5 per cent of the total are shown to have spondylolisthesis (or borderline spondylolisthesis) as against a previous 3.6 per cent. Whereas previously only 4.4 per cent of the cases of spondylolisthesis had had stability studies, these have been made in 82 per cent of the present series. Such studies have also been made in patients without spondylolisthesis, but with bilateral defects of the pars interarticularis. The incidence of instability discovered in the present series was 50 per cent, as compared to a previous 39 per cent.

TABLE II POSITION OF DEFECTS OF THE PARS INTERARTICULARIS IN THE 55 PATIENTS (61 INVOLVED VERTEBRAE)

Vertebra	Unilateral Right	Unilateral Left	Bilateral	Totals	Percentage
L5	9	2	34	45	73.7
L4	1	1	7	9	14.7
L3	2	1	1	4	6.5
L2		1		1	1.7
L1	1			1	1.7
T12		1		1	1.7
Total no of vertebrae involved	13	6	42 (69%)	61	100.0
	19 (31%)				
Total no of patients involved	17* (31%)	40* (69%)	55* (100%)		

\* Two patients had a unilateral and a bilateral defect in separate vertebrae. Two patients had two separate unilateral defects. Two patients had two vertebrae involved, with bilateral defects.

Table II shows which vertebrae were involved and in what percentage of cases. The most frequent sites of involvement were the fifth lumbar, in 73.7 per cent of the cases, and the fourth lumbar, in 14.7 per cent. The upper vertebral bodies were involved relatively infrequently. Bilateral defects were over twice as frequent (69 per cent) as unilateral ones. The number

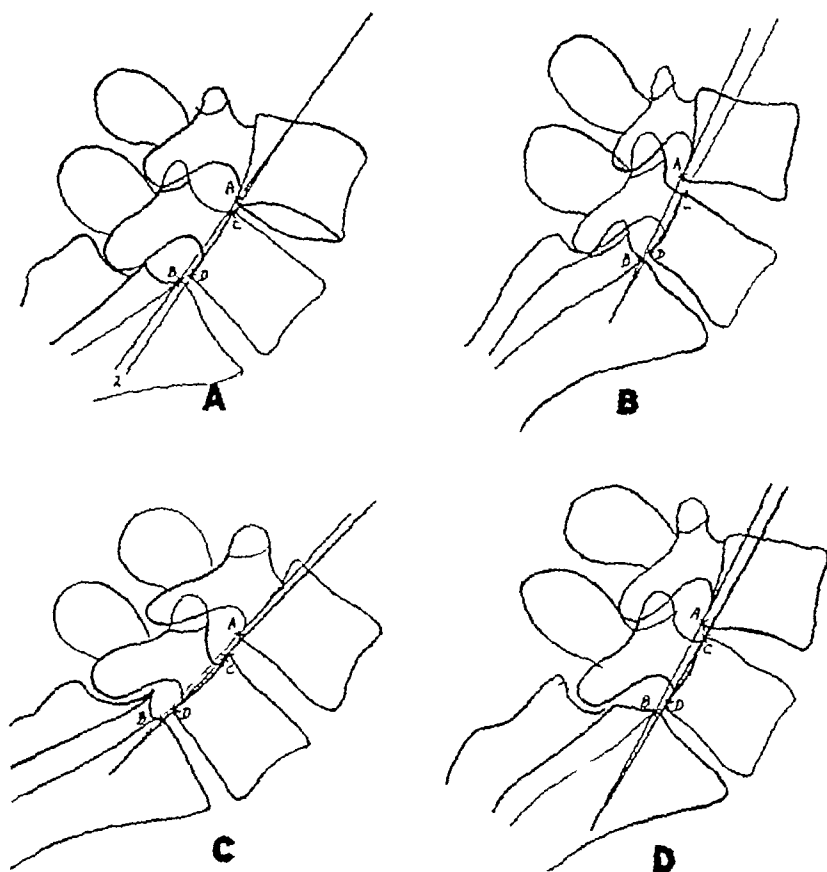


Fig 6 Tracings to show normal changes observed with weight bearing positions  
 A Normal Recumbent neutral projection Lines intersect above L5 but angle is small, less than  $3^\circ$  B Normal Weight-bearing neutral projection C Normal Weight-bearing flexion projection D Normal Weight-bearing extension projection

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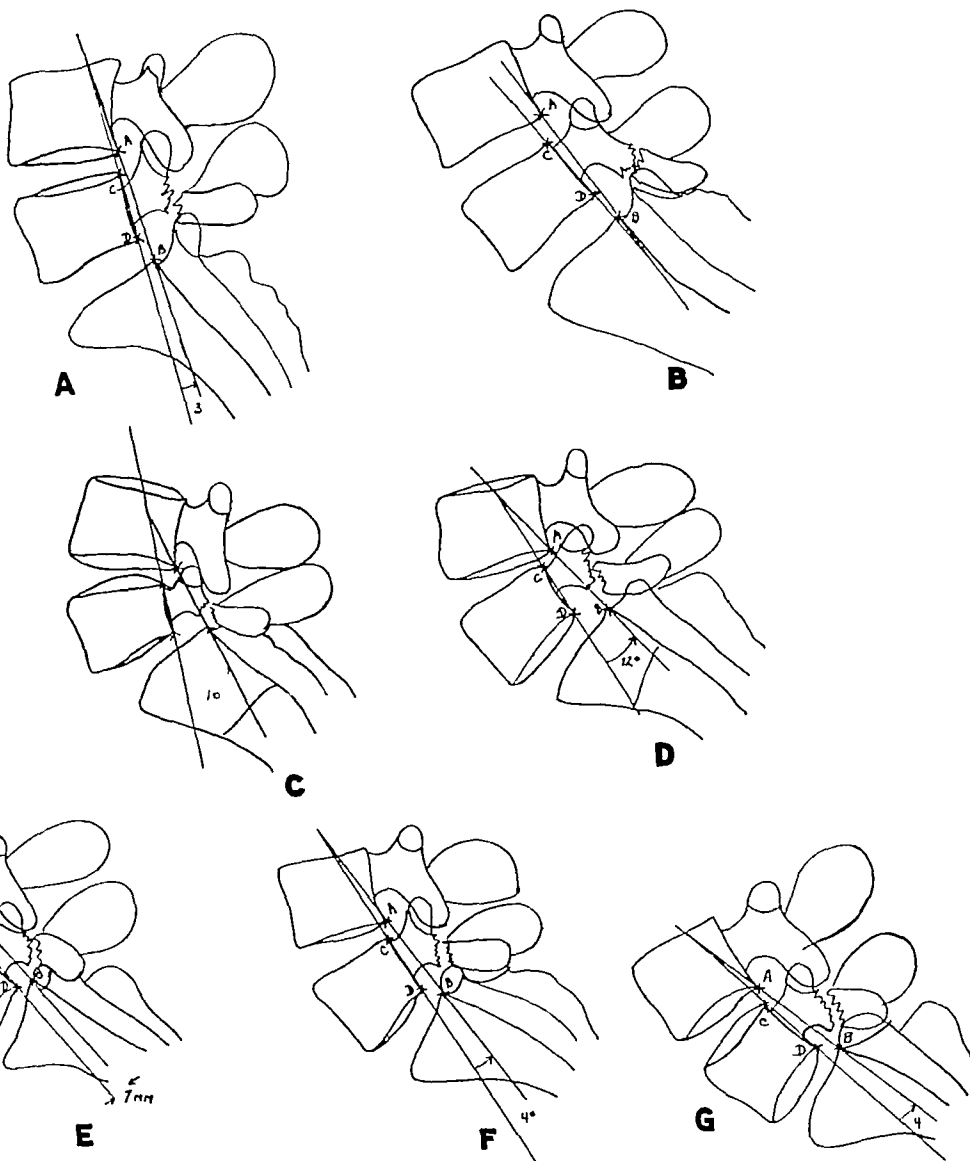


Fig 7 A and B Tracings to show the maximum variation of alignment of the lumbosacral region in borderline spondylolisthesis A Weight-bearing extension B Weight-bearing flexion Very slight mobility of L5 Alignment of vertebral bodies normal in this position

C and D Tracings to show the configuration of the lines indicating the alignment of the lumbosacral region in a case of moderate spondylolisthesis which is slightly unstable C Weight-bearing extension D Weight bearing flexion

E, F, and G Tracings to demonstrate how measurements in the various positions can be compared when a change from the angular to parallel occurs in a given case The inferior relationship in this case remained the same, but there was a change of 2 mm in the superior relationship This type of change is relatively uncommon and we consider a 2 mm change as within the limits of normal E Weight-bearing neutral Lines change to parallel because D remains stable while C moves 2 mm forward with respect to line AB F Weight bearing extension Distance between C and line AB, 5 mm Distance between D and line AB, 7 mm G Weight-bearing flexion Perpendicular distances of points C and D from Line AB are 5 mm and 7 mm respectively

variation of 11 degrees, and one vertebral body with slight spondylolisthesis in the recumbent position increased its degree of slipping 14 to 16 degrees in the weight-bearing positions

It is of interest to note that the classification of some of the cases of spondylolisthesis changed when weight-bearing tests were made (Table VI) Fifty-seven per cent (8 cases) did not change their cate-

TABLE III PRESENCE OF SPONDYLOLISTHESIS IN CASES WITH DEFECTS OF THE PARS INTERARTICULARIS

	Unilateral Defects Only	Bilateral Defects	Percentage
Spondylolisthesis present		26	62
No spondylolisthesis	19	8*	19
Borderline spondylolisthesis		8	19
Total no of vertebrae involved	19	42	100
Total no of patients involved	17	40†	

\* Three of these patients had other evidence indicating a strain on paraspinous ligaments

† Two patients had two vertebrae with bilateral defects. One had spondylolisthesis of both vertebrae, the other had no spondylolisthesis. Two patients had unilateral and bilateral defects

of vertebrae involved exceeded the number of patients, because in two instances the patient had both a unilateral and a bilateral defect, in separate vertebrae, two patients had two separate unilateral defects, and two patients had bilateral defects in two vertebrae (The films on one of the latter are shown in Figure 10)

An analysis of the 42 vertebrae (40 patients) with bilateral defects (Table III) shows definite spondylolisthesis in 62 per cent, 19 per cent were borderline cases, and in 19 per cent there was no spondylolisthesis

TABLE IV DEGREE OF STABILITY OF VERTEBRAE WITH BILATERAL DEFECTS

Presence of Spondylolisthesis	Stable	Unstable—Slight	Moderate	Tests Not Done	Totals
Present	9	12	2	3	26
Not present	6			2*	8
Borderline	5			3	8
Totals	20 (51%)	14 (30%)	8 (19%)	42 (100%)	
Present plus borderline	14	14	6	34	
Percentage of 28 cases (cases studied with stability tests only)	50%	50%		100%	

\* One patient with two vertebrae involved.

None of the 19 vertebrae with unilateral defects only showed slipping of the vertebral body. Three of the 8 patients with-

TABLE V ANALYSIS OF UNSTABLE SLIPPED VERTEBRAL BODIES

Re-cum-bent Measurements	Maximum Degree of Instability in Various Positions			Totals	Per centage
	5-9°	9-14°	14-19°		
3-9°	8		1	9	64
9-19°	4			4	29
20-30°		1		1	7
Totals	12 (86%)	1 (7%)	1 (7%)	14	100%

out spondylolisthesis (but with bilateral defects) had localized lipping of the involved vertebral body to indicate that there was a strain on the paravertebral ligaments in that region

An analysis of the stability of the vertebral bodies with bilateral defects (Table IV) revealed that 51 per cent were stable and 30 per cent unstable, in 19 per cent, stability tests were not carried out. Considering only the 28 cases of borderline and definite spondylolisthesis in which stability studies were done, an equal number were stable and unstable. In only one patient (with two vertebrae involved) without spondylolisthesis were stability tests not done.

Of the 14 unstable cases, 12 were only slightly unstable (less than 10-degree change), and two were moderately unstable (10- to 20-degree change). There were 9 patients with definite spondylolisthesis and 5 with borderline spondylolisthesis whose slipped vertebral bodies were stable.

TABLE VI CHANGE OF CLASSIFICATION OF UNSTABLE CASES OF SPONDYLOLISTHESIS WHEN WEIGHT-BEARING STUDIES WERE DONE

Slight changed to moderate	3 (21 4%)
Slight changed to severe	1 (7 1%)
Moderate changed to severe	1 (7 1%)
Borderline changed to slight	1 (7 1%)
No change	8 (57 1%)
Total	14 (99 8%)

An analysis of the 14 cases with unstable vertebral bodies shows (Table V) 8 cases of slight and 4 cases of moderate spondylolisthesis with a variation of 5 to 9 degrees in the various positions, in one case of severe spondylolisthesis there was a



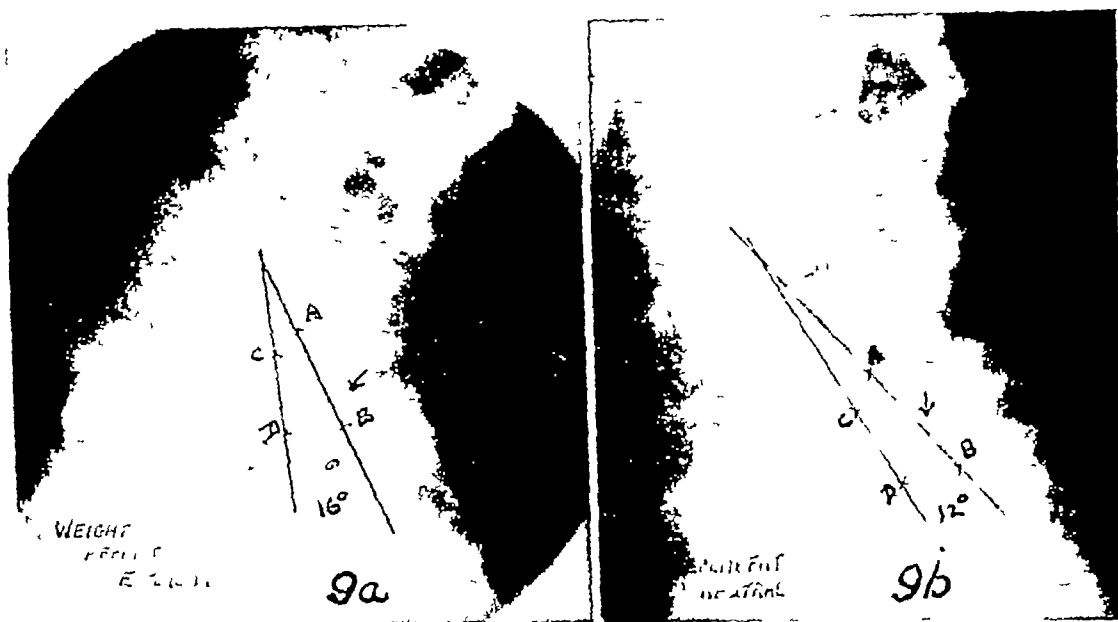


Fig 9 Roentgenograms from a case of moderate spondylolisthesis to illustrate the maximum change which occurred in this case *a* Weight-bearing extension *b* Recumbent neutral

in the various positions. In the fourth, stability tests were not done.

Four patients showed evidence of remote or recent fractures in the spine, one had a narrowed interspace between the fourth and fifth lumbar vertebrae, most likely due to an associated degenerated disk, and 2 patients gave a history of severe trauma to the back shortly before admission to the hospital.

In 3 cases there was localized lipping, either anteriorly or posteriorly, of the involved vertebral body, indicating that there was a severe strain upon the paraspinal ligaments.

One patient had definite roentgenographic evidence of arthritis of the apophyseal joint in the vicinity of the defect in the pars interarticularis, and another had evidence of sclerosis around the defect.

#### DISCUSSION OF STATISTICS

It is interesting to compare our incidence of 11.7 per cent of defects of the pars interarticularis with the 5.0 per cent which Willis (2) found in 1,520 adult skeletons. The difference in the two studies is statistically significant, which is a statistical indication that pars interarticularis defects

are more frequently found associated with back pain than in the population at large.<sup>2</sup> It is well recognized that not all cases even of severe spondylolisthesis are symptomatic. In some cases symptoms are aggravated by an element of psychoneurosis. Nevertheless, the high incidence of spondylolisthesis among patients with low back pain in the Army is noteworthy.

One-half of the slipped vertebral bodies were shown to move significantly when the patient's position was changed. We are not prepared as yet to correlate the matter of instability with signs and symptoms. Two of our unstable cases were asymptomatic, being discovered accidentally in the course of other examinations. Other patients with stable slipped vertebral bodies complained bitterly of pain and limitation of motion. The problem is especially complex in the Army, where symptoms are undoubtedly exaggerated by certain patients or are colored with a strong functional element. Nevertheless, the examination for stability of a slipped vertebral body has

<sup>2</sup> The standard deviation is computed to be 1.62, whereas the difference between the two percentages is 6.7, which is approximately four times the standard deviation. A difference of more than three times the standard deviation is considered statistically significant.

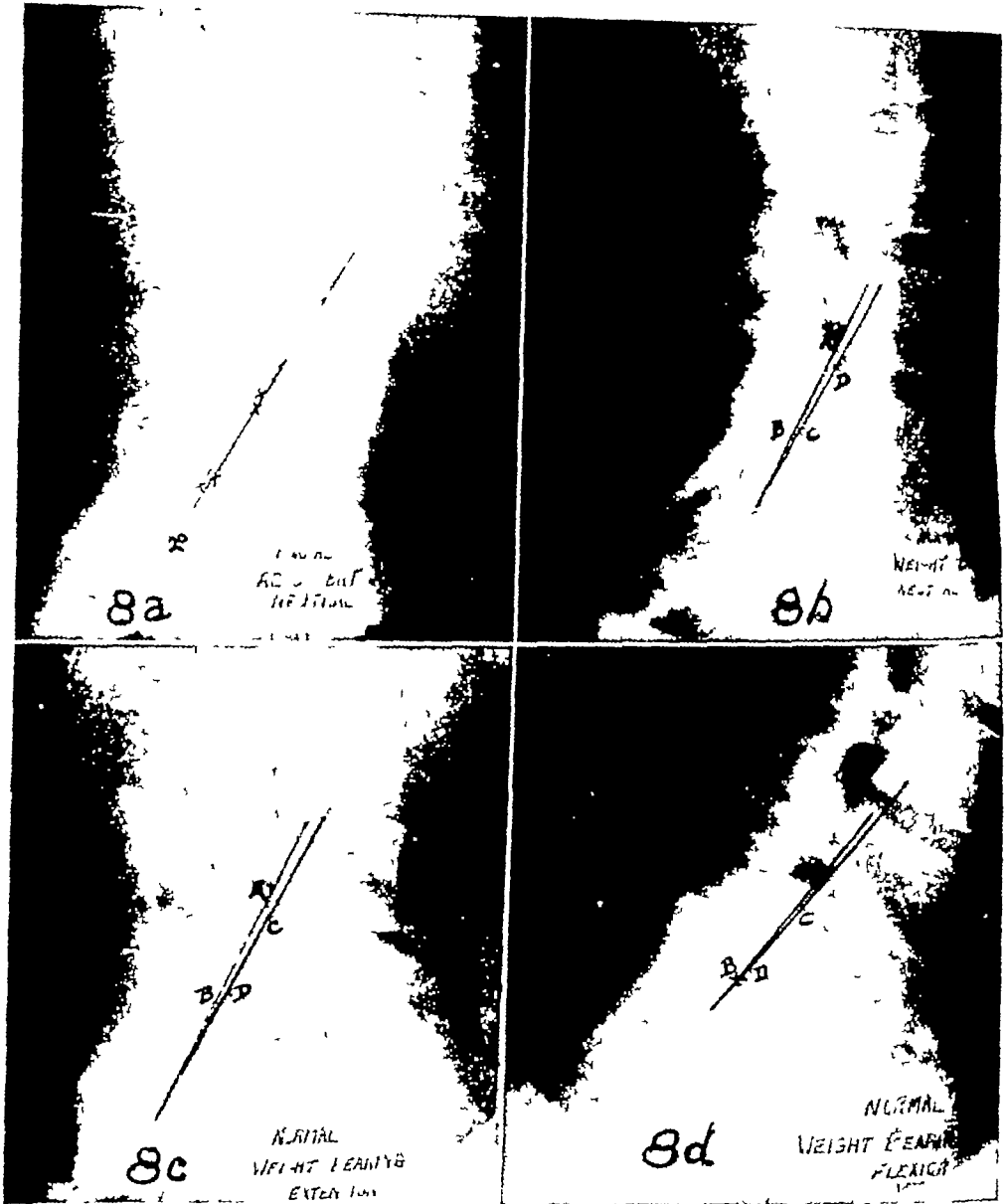


Fig 8 Roentgenograms of a normal spine in various positions a Recumbent neutral b Weight-bearing neutral c Weight bearing extension d Weight bearing flexion

gory,  $21 \pm$  per cent (3 cases) changed from slight to moderate, 7 per cent (1 case) changed from slight to severe, 7 per cent (1 case) changed from moderate to severe, 1 case changed from borderline to slight

#### GENERAL POINTS OF INTEREST

An accurate correlation of our observations with the clinical status of these patients is being carried out at the present

time in collaboration with the orthopedic section. It should be stated, however, that  $\frac{1}{4}$  of our cases were discovered accidentally in the course of other radiographic examinations, in patients with no complaints referable to the back. One of these had instability of 16 degrees, and another instability of 6 degrees. In the third case there was a spondylolisthesis of 10 to 12 degrees but the vertebral body was stable

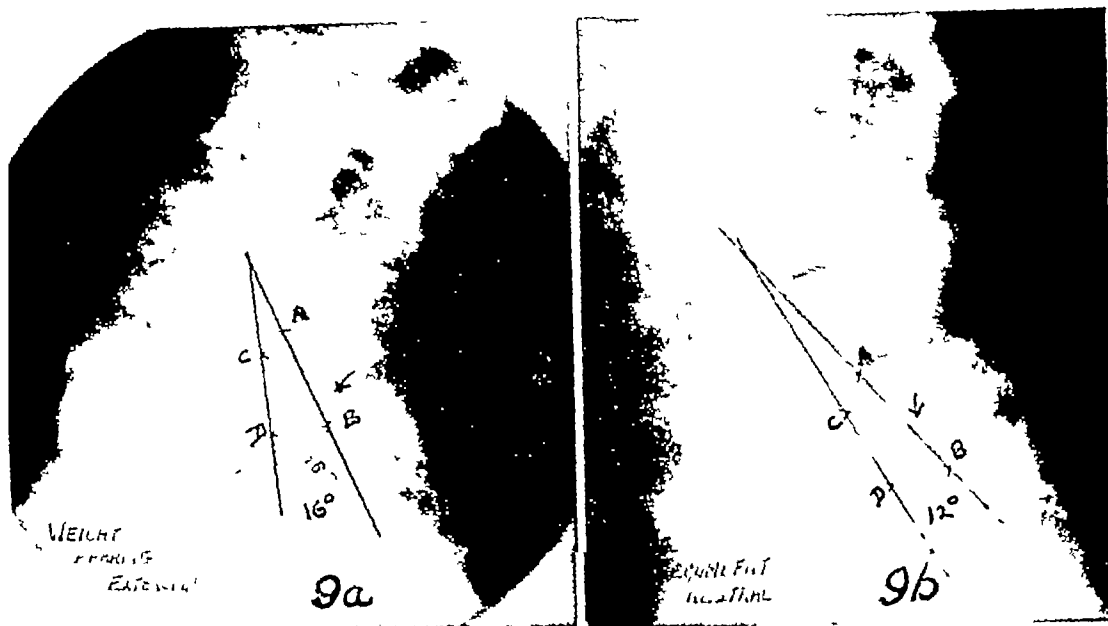


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are more frequently found associated with back pain than in the population at large.<sup>2</sup> It is well recognized that not all cases even of severe spondylolisthesis are symptomatic. In some cases symptoms are aggravated by an element of psychoneurosis. Nevertheless, the high incidence of spondylolisthesis among patients with low back pain in the Army is noteworthy.

One-half of the slipped vertebral bodies were shown to move significantly when the patient's position was changed. We are not prepared as yet to correlate the matter of instability with signs and symptoms. Two of our unstable cases were asymptomatic, being discovered accidentally in the course of other examinations. Other patients with stable slipped vertebral bodies complained bitterly of pain and limitation of motion. The problem is especially complex in the Army, where symptoms are undoubtedly exaggerated by certain patients or are colored with a strong functional element. Nevertheless, the examination for stability of a slipped vertebral body has

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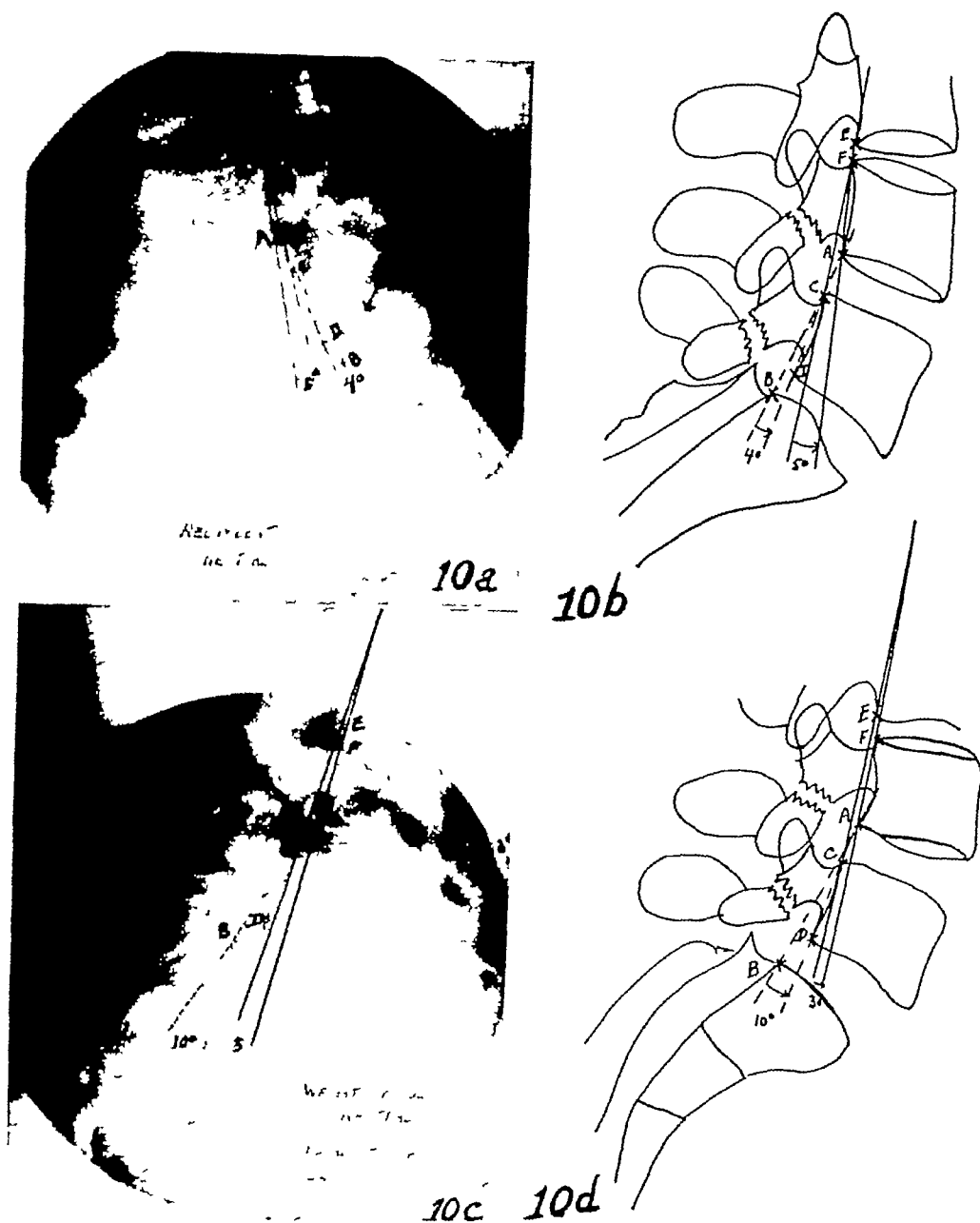


Fig 10 *a-d* Tracings and roentgenograms from a case of spondylolisthesis of both the fourth and fifth lumbar vertebrae. The fourth lumbar is shown to be stable, whereas there is an instability of  $11^\circ$  of the fifth lumbar vertebra. See also Fig 10, *e-h* from same case. *a* and *b* Recumbent neutral. *c* and *d* Weight bearing neutral. Instability of L5. Stability of L4.

already proved its value in giving us a greater understanding of the pathological and physiological changes which occur with spondylolisthesis.

Approximately three-fifths of patients with bilateral defects of the pars interar-

ticularis had definite spondylolisthesis, one-fifth had borderline spondylolisthesis, and the remaining one-fifth had no spondylolisthesis. Even without actual spondylolisthesis, other changes in the vertebral structures must be sought to indicate

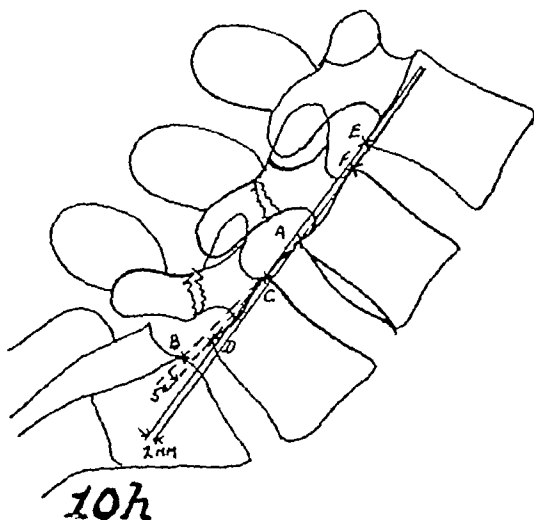
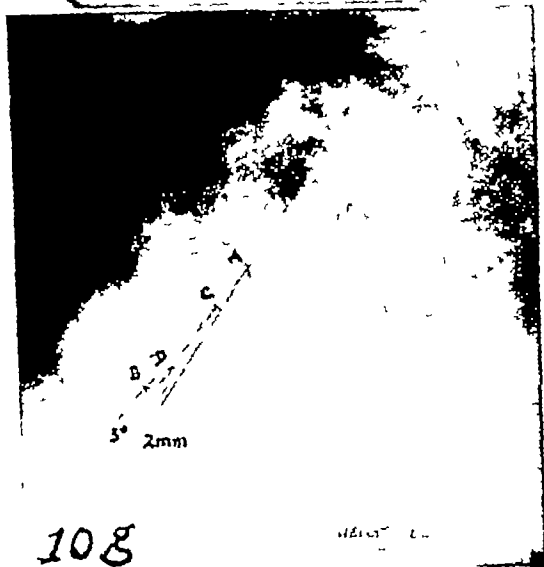
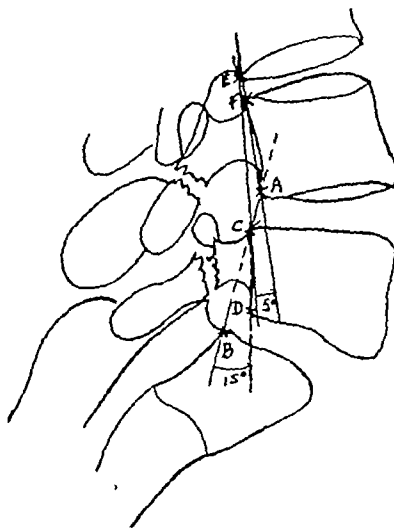
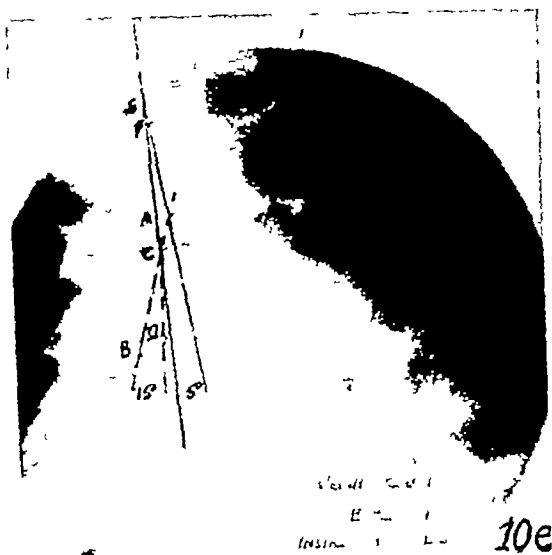


Fig 10, e-h Same case as Fig 10, a-d e and f Weight bearing extension Instability of L5 g and h Weight-bearing flexion

Weight bearing extension Instability of L5 Relative stability of L4

whether or not there is an added strain on the paraspinal ligamentous structures and the joint capsule of the intervertebral joints. We regard such localized changes as lipping, sclerosis around the defect, and changes in the apophyseal joints as very significant.

Most of the unstable cases are only slightly unstable, severe instability is a rare finding. One cannot assume, however, without study, that a slight spondylolisthe-

sis will not become severe with weight-bearing.

#### SUMMARY

1 An improved method of detection and measurement of spondylolisthesis is described.

2 This method has been employed to measure the degree of anteroposterior movement of the slipped vertebral body under various conditions of stress.

3 The mechanism of spondylolisthesis is analyzed, and the limits of normal and abnormal are diagrammatically shown

4 The high incidence of defects of the pars interarticularis and of spondylolisthesis in Army patients is emphasized. Approximately three-fifths of patients with bilateral defects of the pars interarticularis have definite spondylolisthesis, one-fifth have borderline spondylolisthesis, and the remaining one-fifth have no spondylolisthesis. One-half of the slipped vertebral bodies have been shown to be unstable under conditions of stress

5 Even in the absence of instability, there are other indications of strain upon adjoining supporting structures, such as

localized lipping, sclerosis, and apophyseal joint changes

6 The etiology of defects in the pars interarticularis is not definitely known, and although developmental deficiency may play an important part, trauma and stresses and strains are also of probable significance

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# Energy Absorption and Integral Dose in X-Ray and Radium Therapy A Review<sup>1</sup>

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IN LATTER YEARS conceptions of x-ray and gamma-ray dosage have been considerably extended in order to take account of the total energy absorbed throughout irradiated tissues (11, 12, 14, 15, 19, 20, 21). The roentgen is essentially a measure of energy absorption in a given mass of air, and previous investigations had been concerned almost entirely with an attempt to measure at each point in the tissues the energy absorbed near that point, the points considered being most often within the tumour itself. In most methods of radiation therapy, however, particularly in those methods which utilise multiple radiation beams or large radium surface applicators, much radiation is absorbed by the patient which contributes not to the destruction of the tumour itself, but possibly to that of normal tissues of the body. In this respect, it is a familiar fact that the severe constitutional effects of an intensive course of radiation often form an effective bar to higher tumour dosage, and the increase in the degree of these effects with the volume of irradiated tissue is also well known<sup>2</sup> (4, 26). In considering these effects from the physical point of view, one is presumably concerned with the total energy absorbed by the body throughout the whole irradiated volume (the integral or volume dose).

The physical problems of protection of staff and patients also seem to be intimately related to the integral dose, since it seems reasonable to suppose that the blood changes and general effects would depend on the total energy absorbed in the body as a whole and not on the dosage at a particular point (20).

With the recognition of the possible im-

portance of integral dose and the development of a suitable unit for its measurement, considerable work has been done in two main directions which converge toward a common goal. On the one hand, much attention has been given to methods suitable for assessing integral dose in the variety of circumstances that arise in practice and to the chief factors which control integral dose. On the other hand, attempts have been made to correlate integral dose with such clinical and biological observations of radiation effects as would be expected to bear some relation to it. In what follows we shall attempt to give a brief account of this work and to draw some conclusions regarding the present position and value of integral dose and its related conceptions.

## ROENTGEN AND ENERGY ABSORPTION IN AIR AND OTHER MEDIA (14, 20)

As already stated, the roentgen is essentially a measure of energy absorption in air, the factor of proportionality being dependent upon the energy required to produce one ion pair. There is good evidence (8) that this quantity is approximately 33 electron-volts, whence it may be shown (20) that a dose of one roentgen corresponds approximately to the absorption of 85 ergs per gram of air. This quantity, which will be considered a great deal in what follows, may be referred to as a gram-roentgen (20).

The fraction of the energy incident upon a material which is converted into kinetic energy of electrons (9) is  $(\sigma_a + \tau)$ , where  $\sigma_a$  is the true absorption coefficient (recoil electrons) and  $\tau$  is the photo-electric absorption coefficient. Taking account of the magnitudes of these coefficients over a range of wave lengths covering those used in therapy, it can be shown (20) that, in

<sup>1</sup> Received for publication in December 1945.

<sup>2</sup> The actual site irradiated is also a factor, which we shall not consider at this moment.

general, "soft tissues" and "air" are similar to each other, so that energy conversion in air is an approximate measure of the energy absorption in soft tissues provided there is electronic equilibrium

Owing to the greater electron density, the energy conversion per unit mass for short wave lengths will be approximately 10 per cent greater in water or soft tissues than in air, but for longer wave lengths, where  $\tau$  is the most important factor, the lower effective atomic number of water than of air approximately compensates and the real absorption in water would seem to be the same as in air

#### ENERGY FLUX (INTENSITY) AND DOSAGE RATE (16, 17, 20, 21)

It has been shown by Mayneord (20, 21) that if a parallel beam of radiation of intensity  $I$  (ergs/cm<sup>2</sup> sec) is incident upon an elemental mass of air, the dosage-rate  $D$ , in roentgens per second is given by

$$D = \frac{I(\sigma_a + \tau)N}{85} \text{ r/sec} \quad (i)$$

where  $\sigma_a$  and  $\tau$  are the absorption coefficients for air and  $N$  is the number of electrons per unit mass of material. The factor 85 was derived in the previous section

Alternatively, if  $D$  is the total dose recorded when a total energy  $E_0$  flows per unit area in a time  $t$  seconds

$$D = \frac{E_0(\sigma_a + \tau)N}{85} \text{ roentgens} \quad (ii)$$

Using this relation, Mayneord (20, 21) has calculated the dependence upon wave length of the total flow of energy per square centimeter per roentgen measured. His results are shown in Figure 1

Similar results, expressed in a somewhat different form and covering another wave-length range, had previously been obtained by Lauritsen (16, 17)

It is seen that the total energy flow per roentgen is of the order of 3,000 ergs/cm<sup>2</sup> in the short wave-length region but falls to very low values for long wave lengths. For a very extensive medium, which absorbs all the energy, this energy flow

would, of course, be the total energy absorbed per roentgen, and the variation of this quantity with wave length is of considerable importance

When the measurement of dose is made with back-scatter, the analysis is more complex (16, 17, 20) and difficult to make precisely, but the results obtained by Mayneord (broken line of Fig. 1) are a good approximation

In later experimental work Mayneord and Clarkson (22) showed that in general, for whole body irradiation, the energy absorbed per roentgen on the surface does vary in the way predicted by this theory, a result of undoubted importance to protection problems

#### TOTAL ENERGY ABSORPTION (13, 15, 19, 20, 21)

If an absorbing mass (tissue or tissue equivalent) is irradiated, then we may make distribution measurements (as is commonly done) throughout the mass and find for every element of mass  $dm$  within the mass, the dose in roentgens  $D_m$ , delivered. Then the energy absorbed throughout the mass may be written as follows (19, 20, 21)

$$\text{Total energy absorbed} = K\rho \int D_m dm \quad (iii)$$

where  $K\rho$  is a constant of the order of 85 ergs/gm-roentgen and the integral is taken throughout the absorbing mass,  $\rho$  is the electronic density of the medium compared with air. We see, therefore, that the determination of total energy absorbed turns upon the determination of  $\int D_m dm$  for the particular case in question

The quantity obtained by integrating the dose throughout a given mass has been most commonly referred to as the *integral dose* (19, 20, 21), although it has also been called the volume dose (5). When determined, the integral dose is in gram-roentgens, but it is found in practice that this unit is far too small, one million gram-roentgens (a megagram-roentgen) is a more convenient order of magnitude. For a medium of unit density and of atomic number equal to that of air, one mega-



gram-roentgen is approximately equal to 2.02 gm-calories (21)

#### METHODS OF ESTIMATION OF INTEGRAL DOSE

The estimation of integral dose, as we have seen, depends upon the determination, by one means or another, of the integral  $\int^m D_m dm$ . A number of methods have been developed to solve this problem, which depend upon the nature of the case

also been developed for similar measurements in x-ray therapy (3)

For this method a life-size model (see Fig 2) of the body was constructed, consisting of a series of celluloid plates coated with graphite to make them electrically conducting, separated by small air gaps and connected alternately to a battery and galvanometer. When high-voltage radiation falls on this system of ionization

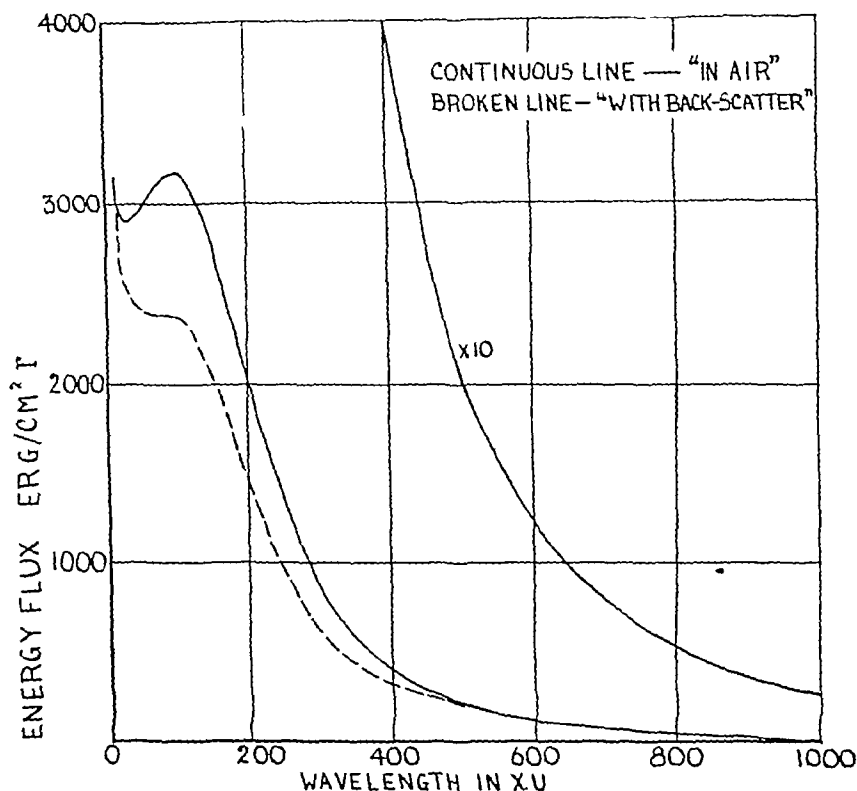


Fig 1 Theoretical relation between energy flux per roentgen at the surface, and wavelength of radiation (Mayneord, 20)

under consideration, the therapeutic method involved etc. We shall attempt to outline these procedures and their results under a number of pertinent headings.

(a) *X-Ray and Gamma-Ray Beam Therapy*. The speediest approach to the determination of integral dose would be to use a method which aims at direct measurement of the quantity, and this approach has in fact been made by Grimmett and his co-workers (3, 11, 12). The method was first devised for the measurement of integral dose in radium-beam therapy (11) but has

chambers in parallel, an ionization current flows which is the sum of all the ionization currents throughout the "body". The thickness of the celluloid plates and the air gaps are so chosen that the over-all density is unity, so that the absorption and scattering will be approximately the same as in a block of tissues and the ionization current proportional to the gamma-ray energy absorbed. The considerations are more complex in the case of x-rays, but it has been possible to make suitable allowances for the differences involved (3).

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where  $K\rho$  is a constant of the order of 8 ergs/gm-roentgen and the integral is taken throughout the absorbing mass,  $\rho$  is the electronic density of the medium compared with air. We see, therefore, that the determination of total energy absorbed turns upon the determination of  $\int D_m dm$  for the particular case in question

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$$\Sigma = D_m \int_{D_1}^{D_2} 2\pi r da = D_m V \quad (v)$$

where  $V$  is the volume between the isodose surfaces. Mayneord (20) has given an elegant method of finding  $V$  by means of a practical measurement of the moment of the area considered about the central axis.

In cases where the beam is considerably angled to a patient, some of the isodose surfaces will be cut by the body surface, and to determine the integral dose it is necessary to estimate the sizes of the portions of the interisodose volumes which actually lie within the body. Bush (1) has described a method and apparatus which solve this problem.

For the rapid routine calculation of integral dose from standard depth-dose data, Mayneord (20, 21) and Haphey (13, 15), by somewhat different methods, have derived approximate formulae. Mayneord's method (20, 21), which is possibly the simplest to understand, is as follows:

Suppose a parallel beam of radiation of cross section  $A$  sq. cm. falls normally on the surface of an absorbing medium. To a first approximation the dose contours may be regarded as rectangular and reaching to the geometrical limits of the beam. Then, assuming the fall of dose with depth to be exponential,<sup>4</sup> the dose at  $x$  cm. depth will be  $D_0 e^{-\mu x}$  where  $D_0$  is the surface dose. Thus the integral dose  $\Sigma$  to a depth  $d$  cm. in a medium of unit density is

$$\Sigma = \int_0^d D_0 A e^{-\mu x} dx = \frac{A D_0}{\mu} (1 - e^{-\mu d}) \quad (vi)$$

If the depth  $d$  is very great, so that all the energy is absorbed,

$$\Sigma = D_0 A / \mu \quad (vii)$$

In practice, it is more convenient to use  $d_{1/2}$ , the depth at which the dose falls to half its surface value. Then  $\mu d_{1/2} = 0.693$  so that  $\Sigma = 1.44 D_0 A d_{1/2}$  is a convenient statement of the total energy absorbed.

If a closer approximation is taken, in which the dose is assumed to be constant to a depth  $d_0$  and then to fall exponentially,

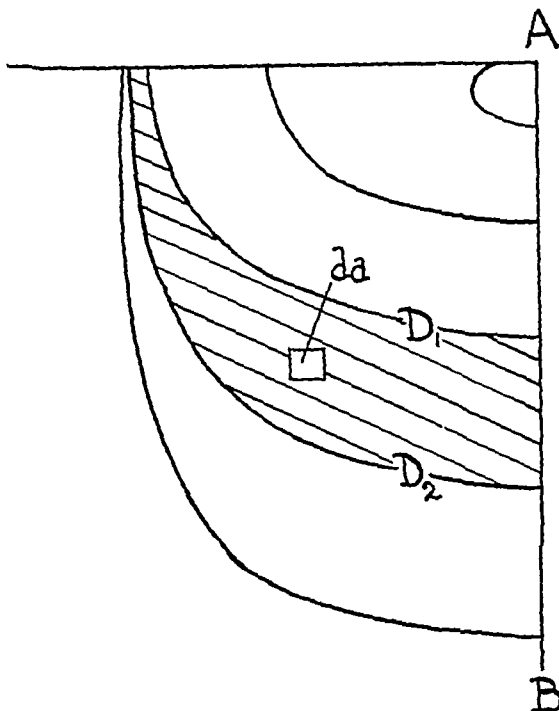


Fig. 3. Determination of integral dose from dose contours.

while  $d$  is assumed to be measured from  $d_0$  and not from the surface, then the total energy absorption is

$$\Sigma = D A [d_0 + 1 + d_{1/2}] \quad (viii)$$

If a diverging beam from a point source at FSD  $f$  cm. is considered, the absorption to a depth  $d$  has been shown to be (19)

$$\Sigma = \frac{D A}{f^2} \left[ \left( \frac{f^2}{\mu} + \frac{2f}{\mu^2} + \frac{2}{\mu^3} \right) - e^{-\mu d} \left( \frac{f^2}{\mu} + \frac{2f}{\mu^2} + \frac{2}{\mu^3} \right) \right] \quad (ix)$$

and for complete absorption

$$\Sigma = \frac{D A}{\mu} \left[ 1 + \frac{2}{f\mu} + \frac{2}{f^2\mu^2} \right] \quad (x)$$

or

$$\Sigma = 1.44 D A d_{1/2} \left[ 1 + \frac{2.88 d_{1/2}}{f} + \frac{4.16 d_{1/2}^2}{f^2} \right] \quad (xi)$$

which is the formula normally employed in practice in calculations on patients, taking into account the exit dose if this is appreciable.

<sup>4</sup> There is evidence to show that this is so in many instances.

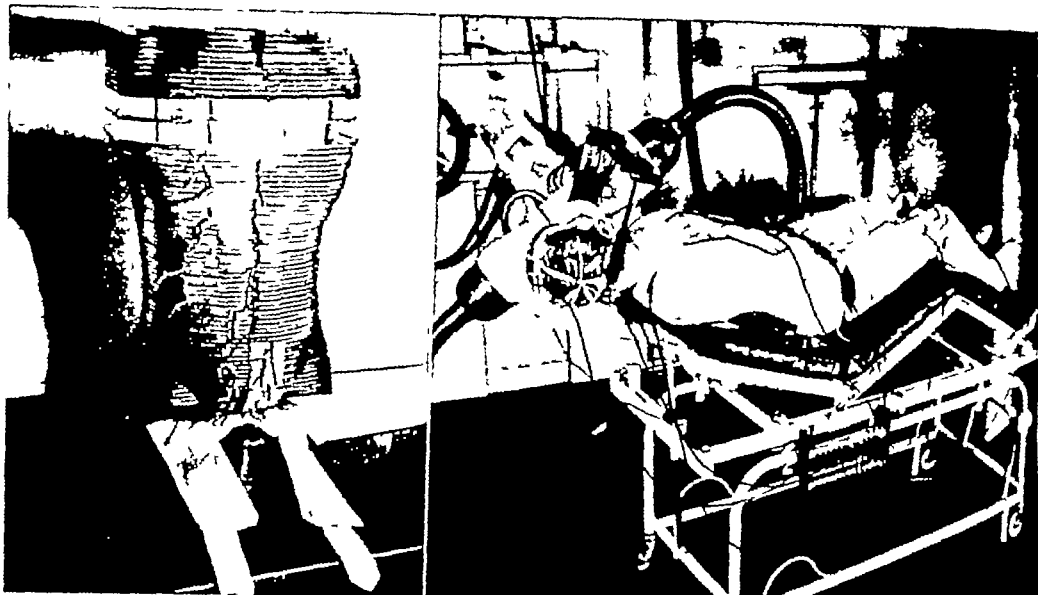


Fig 2 A (left) Method of construction of celluloid man B (right) Complete celluloid man having x-ray "treatment" (Boag, 3)

In practice, for satisfactory behaviour, it was found that the celluloid man had to be fitted with thin celluloid gaskets between the edges of the plates in order to exclude dust, and with earthed guard-rings around the edges of the plates in order to prevent the collection of ions from the heavily ionized air around the model

Another method of direct measurement which might be valuable, though little experimental work has yet been done on the subject, would be to utilise the chemical changes brought about by high-voltage radiations (21). It should be possible, for example, to use a reaction such as the precipitation of mercurous sulfate from Eder's solution, using a phantom the shape of the body filled with the solution

Yet another way in which the problem has been solved is by the use of a large number of condenser ionization chambers so placed as to measure the mean dose at the centre of mass of equal masses distributed throughout the whole volume of a suitable model of the tissues being irradiated (21, 22). With a condenser chamber at the centre of mass of each sufficiently small mass, the integral is transformed into a summation and it is necessary merely to add together the indications of all the

chambers to obtain a quantity proportional to integral dose

In spite of their great interest and value, the methods so far described are hardly suitable for dealing with routine estimation of integral dose for the large number of conditions which may arise, and it becomes apparent that methods based upon standard dosage data are much to be preferred for the purposes.<sup>2</sup> Methods of this kind have been developed (13, 15, 20, 21)

When the dose-contours (in roentgens) for a circular beam of radiation have been determined, the integral dose due to the beam may be derived as follows (20, 21)

The integral dose in a ring element (Fig 3) of cross-sectional area  $da$  is  $D \times 2\pi r da$ , where  $D$  is the dose in roentgens at  $da$

The integral dose  $\Sigma$  between the surfaces generated by rotation of the contours  $D_1$  and  $D_2$  about the central axis is

$$\Sigma = 2\pi \int_{D_1}^{D_2} D r da \quad (iv)$$

or, if we take the mean dose  $D_m = \frac{D_1 + D_2}{2}$ ,

the integral dose is

<sup>2</sup> The celluloid-man method is possibly suitable for routine investigation but even this involves considerable experimental facilities and the use of the radiation apparatus for periods when the clinicians would no doubt require it for the treatment of patients

(c) *Whole Body Irradiation* The question of the total amount of energy absorbed by the body when the whole or a considerable part of it is subjected to radiation is obviously of some importance, particularly in connection with protection and also in connection with the "wide-field" (bath) techniques of x-ray therapy advocated by Scott (27). Consequently these questions have been studied in some detail (22, 23).

For this study Mayneord and Clarkson (22) constructed a model of a patient having elliptic cross sections at all levels (see Fig 4), and composed of paraffin wax and slabs of mixed rice flour and sodium bicarbonate (29). The method used was that already referred to, in which condenser ionization chambers are placed at the centre of mass of equal "cells" of a given section, although in actual fact the integral dose was obtained by interpreting the data in three different ways. The radiations studied covered half-value layers ranging from 0.037 mm Cu (40 kv) up to 16 mm Cu (gamma rays of radium).

These authors (22) also studied the variation of integral dose with direction of the x-ray beam and, using the reciprocity relationships already mentioned, they found values for external radium sources, as well.

The effects upon integral dose of such variables as quality of radiation, FSD, size and shape of patient, have been examined in a paper by Mayneord (23), which also brings to light a number of theories and procedures of value in the assessment of integral dose.

For investigation of these same questions the celluloid man is also of great value, giving as "he" does, direct readings of the quantity required for any set of conditions.

#### SOME PHYSICAL DATA OBTAINED FROM INTEGRAL DOSE STUDIES

Under this general heading it is proposed to set out some of the more important physical results which have been obtained by the use of the methods outlined above.

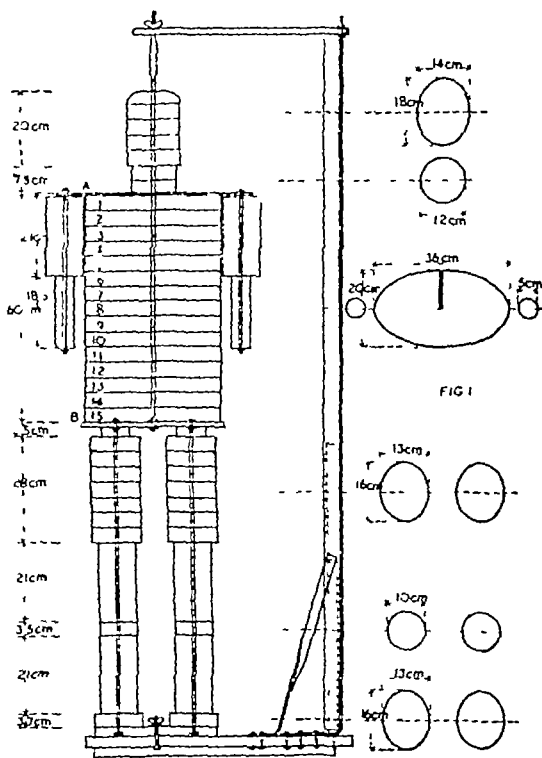


Fig 4 Construction of wax man (Mayneord and Clarkson, 22)

(a) *X-Ray and Gamma-Ray Beam Therapy* Mayneord (20) has examined the integral dose (measured to the 10 per cent isodose surface) due to circular beams of radiation for a number of different therapeutic conditions when the same fixed dose of 100 r is measured with back-scatter at the surface. His results are shown in Table I. One sees at once how very different is the energy absorption with the different techniques.

It is seen from equation (1) that, other things being equal, the integral dose may be expected to increase roughly in proportion to the field area. The proportionality is not exact because the surface dose depends upon back-scatter, and thus in its turn depends upon the area of field. The equation also indicates how integral dose depends on FSD and quality, since  $d_{1/2}$  is determined essentially by the quality of the radiation.

Boag (3) has described the results of measurements of integral dose made directly with the celluloid man for x-rays of

In this case again, it is possible to assume a constant dose to a small depth  $d_0$  and to make the necessary modifications to the formulae (20)

(b) *Radium Therapy* In radium therapy by the methods of surface, intra-oral, and interstitial application, the conditions may be even more diverse than in x-ray therapy, and a great variety of relationships between radium sources and irradiated body have to be considered. Direct measurement with the celluloid man would appear the most readily applicable method of estimation of integral dose in these cases but, for reasons already given, additional methods are necessary.

In the past, the general problems of radium dosage have yielded very well to mathematical methods (30), and the problems of integral dose are no exception, it is the mathematical approach which so far has been the most fruitful of methods for the estimation of integral dose in radium therapy (2, 20, 23, 24, 25, 31). In this respect, the study of point sources is of first importance. Thus, suppose we have a 1-mg point source of gamma radiation filtered by 0.5 mm Pt in an extensive medium of unit density, then the dose  $D$ , at a distance  $r$  cm is found experimentally (20, 24) to be approximately

$$D_1 = \frac{8.3}{r^2} e^{-\mu r} \text{ roentgens per mg-hour} \quad (\text{vi})^6$$

and integral dose calculations in gamma-ray therapy are largely the integration of this expression throughout masses of tissue of different shapes and sizes, a procedure which is possible analytically only in a small number of simple cases (24).

If the source is at the centre of a sphere of radius  $a$  cm, the integral dose in the sphere is (24)

$$\Sigma = \int_0^a \frac{8.3}{r^2} e^{-\mu r} 4\pi r^2 dr = \frac{104.3}{\mu} (1 - e^{-\mu a}) \quad (\text{vii})$$

<sup>6</sup> The factor 8.3 is the dosage rate in r/hr at 1 cm distance from a 1-mg point source of radium element filtered by 0.5 mm Pt.  $\mu$  is of the order of  $0.028 \text{ cm}^{-1}$  but depends also on the extent of the medium and probably on  $r$  (24).

while if the medium is of infinite extent, the total energy absorbed in it is

$$\Sigma_{\text{total}} = \int_0^\infty \frac{8.3}{r^2} e^{-\mu r} 4\pi r^2 dr = \frac{4\pi \times 8.3}{\mu} = \frac{104.3}{\mu} \quad (\text{viii})$$

Putting  $\mu = 0.028 \text{ cm}^{-1}$  in (viii), we find  $\Sigma_{\text{total}} = 3,725$  gram-roentgens per mg hr, a result which agrees very well with that obtained from an absolute energy standpoint (9, 24). This is the maximum possible integral dose when all the gamma ray energy is absorbed.

Similarly, if the point where the radium is situated is not at the centre of the sphere, but displaced a distance  $c$  cm from it, the integral dose in the sphere is (24)

$$\Sigma = 8.3\pi \left\{ 2a + \frac{a^2 - c^2}{c} \log \frac{a+c}{a-c} \right\} \quad (\text{ix})$$

When  $c = a$ , so that the radium is on the surface of the sphere, the integral dose is  $8.3 \times 2\pi a$ , that is, one-half the value when it is at the centre.

Mayneord (24) has also shown that, in general, the integral dose throughout any volume whatever, due to a finite source uniformly filled with radioactive material, is equal to the integral dose throughout the original source if the "receiver" be filled with radiating material of the same uniform density. Thus, in any case where the distribution of radiation due to a continuous distribution of radioactive material has been calculated (30), the integral dose may be written down in the inverse problem. A number of examples of such calculations and their practical applications have been described (24, 31).

The calculations become considerably more complex when absorption of radiation is taken into account (2, 24), but tables of data have been drawn up (2) which enable the integral dose throughout the body to be assessed fairly precisely for most radium therapy techniques (2). Absorption of radiation within the medium does not prove to be so serious a factor as one might have expected.

similar data for radium teletherapy given by Bush (1). In the same paper (5) Ellis has shown that in the treatment of carcinoma of the oesophagus by the technique of Table II the integral dose with a focus-skin distance of 40 cm is 25 per cent greater than with a distance of 100 cm.

The effect of quality upon total energy absorbed during treatment has been well exemplified by Phillips (26). Referring

(b) *Radium Therapy* Using the mathematical methods already outlined, Mayneord (24) has calculated, as representative examples, the integral dose in the head during the use of radium in the antrum and during the treatment of the lip with a surface applicator, also the integral dose in the trunk during the treatment of sites such as the cervix and oesophagus. Lederman and Clarkson (18) have determined

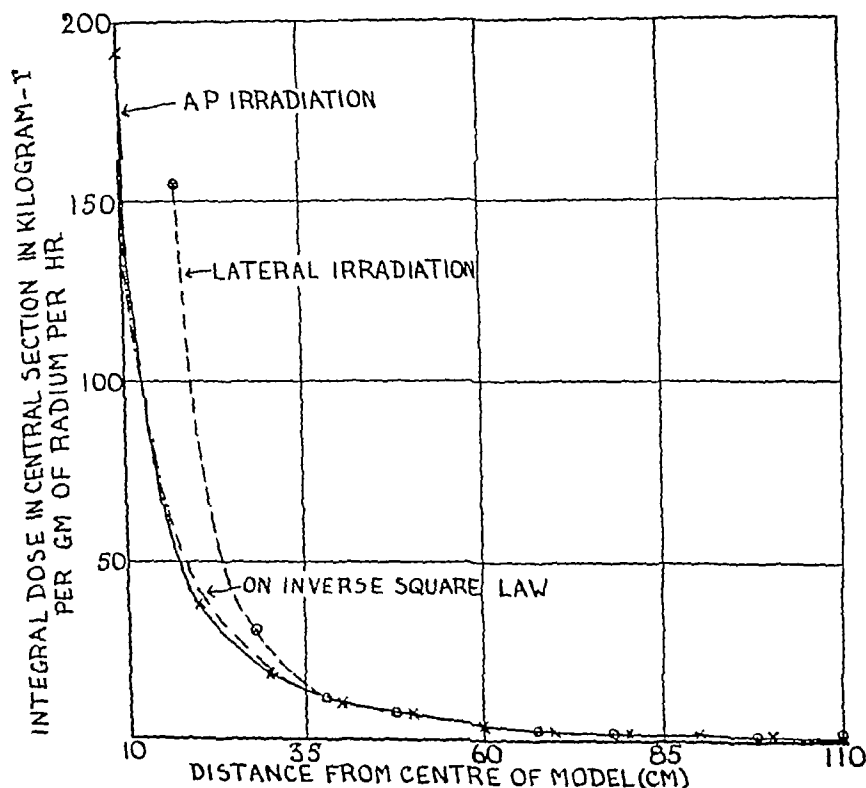


Fig 5 Whole body integral dose for radium at various distances outside the body (Mayneord and Clarkson, 22)

to the treatment of carcinoma of the rectum by supervoltage x-rays (1,000 kv and HVL 90 mm Cu, FSD 100 cm), Phillips states that the average integral dose is about 40 megagram-roentgens and produces definite impairment of the patient's vitality, from which recovery occurs in about two months. "At 200 kv the integral dose would be over 60 megagramme-r, which is higher than has yet been given in any condition, and would almost certainly impair the patient's vitality to a critical degree."

the integral dose delivered to the trunk during radium bougie treatment of cancer of the oesophagus, using the known dose contours around the bougie. They found the integral dose to be 3.15 megagram-roentgens for a treatment of sixty hours' duration. With Mayneord's method of calculation, the result was approximately 4.0 megagram-roentgens, the difference being probably due to the fact that the latter method takes no account of absorption.

Wilson (31) has used the mathematical method to calculate the integral dose re-

TABLE I INTEGRAL DOSE DUE TO CIRCULAR BEAMS OF RADIATION FOR DIFFERENT TECHNIQUES (MAYNEORD)  
(100 r measured with back-scatter at the surface)

Technique	Potential, kv	Filter	Mean Wave Length, Å	F S D, cm	Diameter of Field, cm	Gram Roentgens to 10% Contours
<b>X-rays</b>						
Roentgen cautery	45	Unfiltered Tube only	0.90	2.0	1	71.5
Contact therapy	60	Tube only, 0.2 mm Ni equiv	0.33	5.0	4	4,200
Deep therapy	200	1.0 mm Cu	0.12	50.0	10	96,560
Supervoltage	400 (peak)	4.0 mm Cu	0.069	50.0	10	110,000
<b>Gamma rays</b>						
1-gm unit		1.0 mm Pt equiv	0.014	5.0	5	14,583
5-gm unit		1.4 mm Pt equiv	0.013	8.0	8	51,387

TABLE II X-RAY TECHNIQUE, SITE, AND TOTAL ENERGY ABSORPTION OR INTEGRAL DOSE (ELLIS)  
(H V L 1.5 mm Cu, F S D 40 cm)

Region	Tumor Dose, r	Fields	Integral Dose, megagram roentgens
		Num-ber Area, cm <sup>2</sup>	
Tonsil	4,500	2 × 10/8 2 × 6/4	7.77
Fauces	4,000	2 × 10/15 2 × 6/4	11.26
Larynx	5,000	2 × 6/8 1 × 6/4	4.53
Brain	4,000	2 × 10/8 1 × 6/8	11.94
Bladder	5,600	8 × 8/10	17.24
Pelvis	3,000	2 × 20/15	25.94
Supplement to radium	3,000	2 × 20/15	
Oesophagus	6,000	8 × 15/4	31.1
Lung	4,000	4 × 10/15	30.3
Lung	5,500	5 × 6/8	19.0

half-value layer between 2 and 4 mm Cu. He found that the absorption of energy depends chiefly upon the area and site of the field and to a much smaller extent upon focus-skin distance, linear dimensions of the patient, and half-value layer of the radiation. He gives curves from which the integral dose can be estimated rapidly.

In therapeutic practice the conditions are much more complex than we have considered so far, a number of cross-firing beams being used. We see from Table I that it is in deep x-ray therapy, supervoltage x-ray therapy, and radium beam therapy that the question of integral dose is met most severely and it is in these fields, therefore, that integral dose has been studied. The order of magnitude of integral dose for various techniques is of great interest, in

particular, the relative merits of one technique with respect to another. The effect of F S D and quality of the beam upon the integral dose in therapy is of significance in relation to integral dose because these factors in their turn affect the depth dose values, these values decide the amount of treatment required through each field in order to deliver a specified tumour dose. If the depth doses are in

TABLE III INTEGRAL DOSE IN RADIUM TELETHERAPY (BUSH)

Site of Disease	Number and Diameter of Fields			Integral Dose megagram roentgens
	3.5 cm	5.0 cm	8.0 cm	
Pharynx	1	2	2	5.89
		3	2	5.33
			2	4.20
	2	2	2	5.99
		3	1	5.41
		2	3	5.49
Posterior Larynx		3	2	6.18
			2	3.65
Floor of mouth		2		1.84
	2	3	1	5.19
		5	1	3.50
Tongue	1	5	2	7.19
		4	2	6.26

creased, the amount required will be smaller and therefore may, in some circumstances, lead to a reduction of the integral dose for the same tumour dose.

The magnitude of integral dose, and its dependence upon the type of deep therapy technique and site irradiated, are well illustrated in Table II, taken from papers by Ellis (5 and 6). Table III shows some



n Figure 5, where comparison with the inverse-square law has also been made on the basis of the experimental value at 70 cm distance. The rapid increase in integral dose as the source approaches the body is noteworthy.

(c) *Whole Body Irradiation* As a result of investigations with the wax man already referred to (22), the variation of integral

sent the integral dose when the patient is exposed to a divergent beam with its axis normal to the centre of the trunk so that the dose at the extremities of the body is smaller than at the centre. Those marked  $\Sigma'$  are for a beam imagined modified so as to make the surface dose with back-scatter constant at all points on the patient's anterior surface.

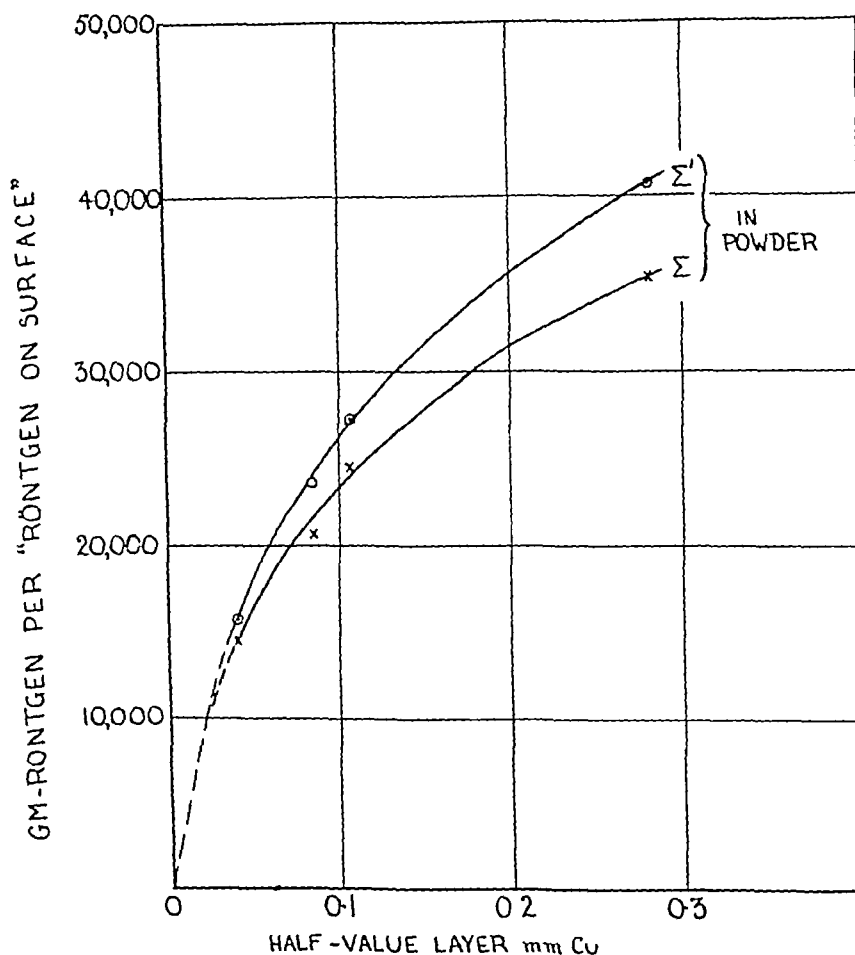


Fig 6B (Mayneord and Clarkson, 22)

dose with half-value layer of radiation has been found to be as shown in Figure 6 (A and B). The curves marked "in powder" represent the results obtained when the model is of a powder mixture of rice flour and sodium bicarbonate, which is very closely equivalent to water (29), they are therefore the better representation of the results from the point of view of clinical practice. The curves marked  $\Sigma$  repre-

In Figure 7 (22) these results are compared with the theoretical calculations previously discussed (see Fig 1), where it is seen that, for short wave x-rays or gamma-rays, approximately one-third of the energy falling on the patient is absorbed, but for long wave lengths approximately all the energy is absorbed. The apparent excess of absorbed energy at the short wave lengths is probably due to the heterogen-

ceived by the trunk in the treatment of breast cancer by interstitial and surface radium therapy in order to correlate the values with blood counts. He gives graphs which show the variation of integral dose in the trunk, (a) with position of the radium along the trunk, and (b) with distance of radium beyond the trunk. Also, on the basis of certain simplifying assump-

used by Mayneord and Clarkson for their investigations of total body dose (22). His results were summarised in the form of tables and graphs, which enable a reasonably accurate estimate to be made of the integral dose received by the whole body from radium used in any practical case. Thus he gives a curve for radium disposed on or near the central axis of the body and

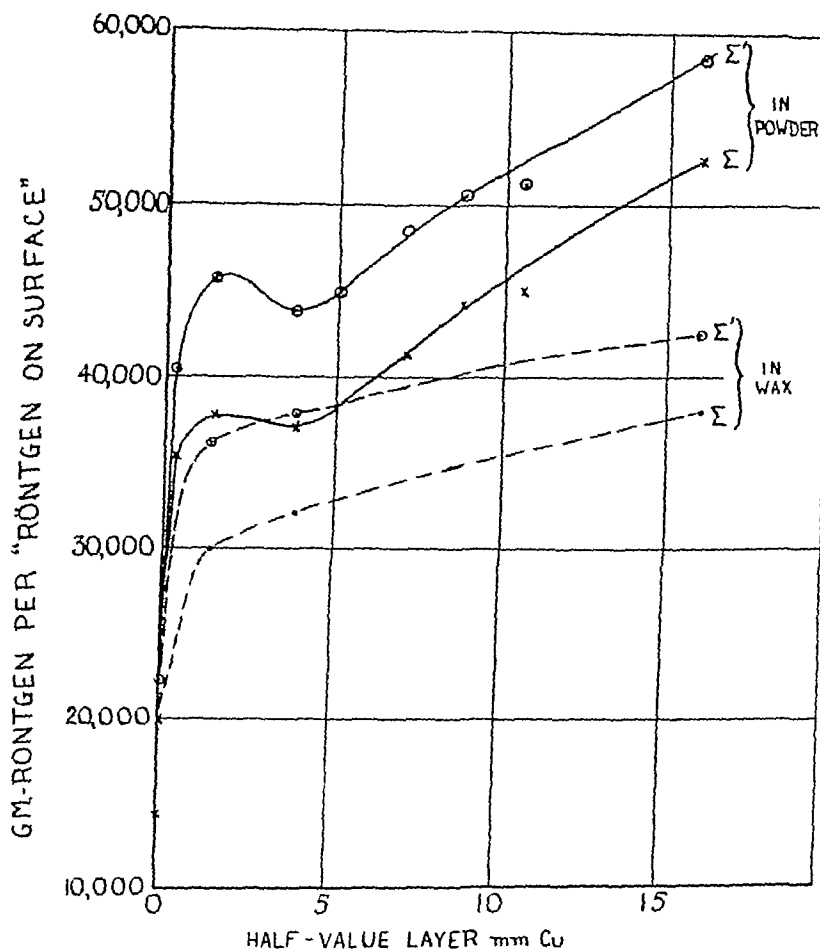


Fig 6A (Mayneord and Clarkson, 22)

tions, he presents other graphs relating integral dose in the trunk due to surface applicators to the area of applicator, the radium-skin distance, and surface dose.

In a very recent paper, Bush (2) has made calculations of the integral dose throughout the whole body, by means of formulae which take account of absorption. For this purpose he has assumed a "man" of practically the same construction as that

a table for radium placed near the surface of the trunk. The latter is reproduced in Table IV.

A study has also been made of the integral dose due to a small source of radium outside the body (22). The changes in integral dose as a radium source is moved away from the patient were determined. The values so obtained for a central section of the trunk (of a wax man) are given

lem fraught with difficulty. It is still not solved to any degree of satisfaction in the case of malignant disease of even the most local character. It is therefore not to be wondered at that progress in the direction of correlating the general effects of irradiation with integral dose has lagged consider-

terladium (5-gm unit) for disease at sites in the head and neck, *viz*, pharynx, post-cricoid, larynx, floor of mouth and tongue. The average energy absorption during treatment was 5.35 megagram roentgens, and Bush states that the general effect of this treatment is fairly severe and that the

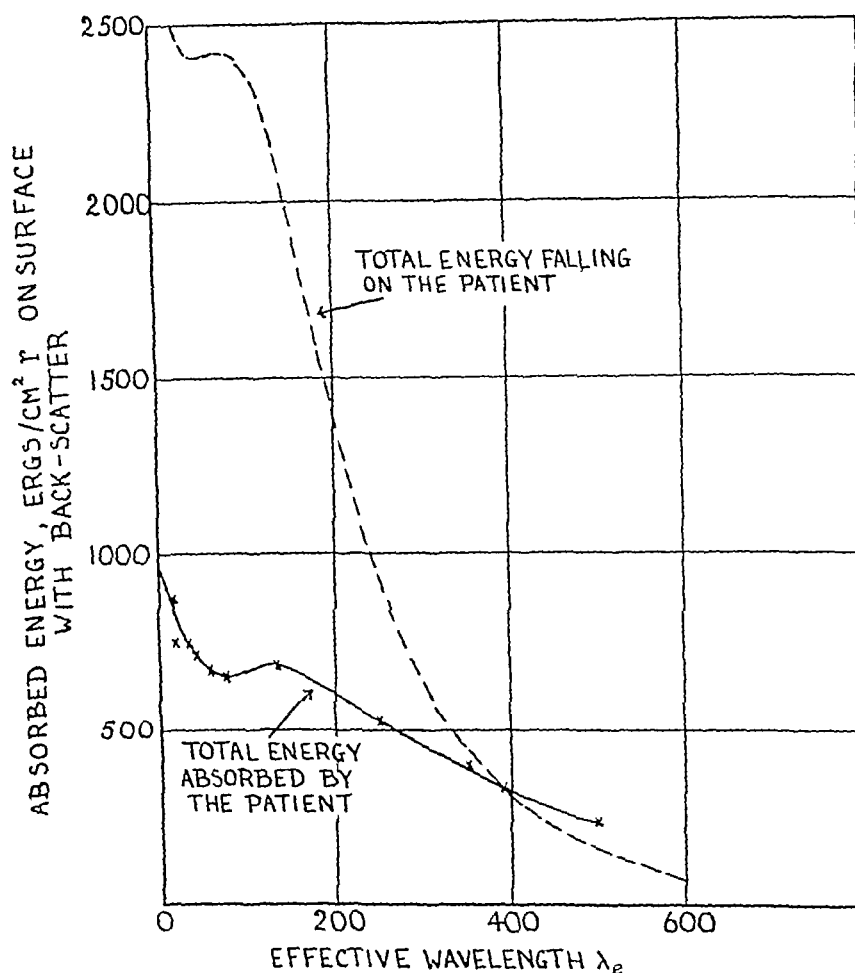


Fig 7 (Mayneord and Clarkson, 22).

ably behind the development of the concept of integral dose itself. The physicist's problems in this matter, difficult enough in themselves, are comparatively simple in relation to those of the clinician. In spite of these difficulties, however, some progress has been made.

Some of the most definite results that have been obtained are those of Bush (1), who studied very precisely the energy absorption in a series of 26 cases treated by

patients had nearly as much treatment as they could stand from the point of view of their general condition. Further, Bush was able to relate the energy absorbed and the lymphocyte count, as shown in Figure 8. The curve has been interpreted by Bush as indicating the presence of several strains of lymphocytes of different sensitivity in the 26 patients from whom the figures were obtained.

Results obtained by Wilson (31), using

TABLE IV ENERGY ABSORPTION IN GRAM ROENTGENS PER MILLIGRAM-HOUR FOR RADIUM NEAR SURFACE OF TRUNK (BUSH)

Plane	Angle from Mid-Axillary Line, degrees	Distance Deep to Skin, cm				Radium-Skin Distance, cm		
		3	2	1	0	1	2	3
A	0	759	720	680	628	530	485	440
	30	807	747	682	597	516	457	410
	60	855	774	684	577	490	429	380
	90	920	810	685	569	461	391	340
B	0	1192	1125	1010	740	575	492	420
	30	1176	1093	988	780	611	518	440
	60	1163	1074	960	807	636	534	450
	90	1160	1065	952	817	646	543	460
C	0	1200	1135	1020	741	582	498	420
	30	1190	1110	995	795	624	532	450
	60	1182	1095	975	836	656	561	480
	90	1180	1085	972	846	666	566	480
D	0	1215	1140	1045	751	584	498	420
	30	1210	1130	1025	822	640	554	480
	60	1207	1124	1013	870	692	599	510
	90	1205	1120	1005	892	714	610	530
E	0	1040	910	850	726	562	483	400
	30	1130	1030	962	793	624	524	460
	60	1220	1134	1037	855	673	553	480
	90	1240	1160	1050	865	686	566	490
F	0	1060	950	820	685	537	460	390
	30	1184	1097	990	796	633	532	460
	60	1261	1213	1126	870	699	590	510
	90	1308	1242	1160	886	712	603	530
G	0	1045	950	770	675	533	433	340
	30	1089	1009	910	732	582	489	420
	60	1100	1059	984	760	611	515	430
	90	970	900	760	678	554	461	420

icity of the beams used in the experiments "Generally, we may say that the integral dose per roentgen on the surface varies in the way predicted by the theory that it rises only slowly with half-value layer above the region of 5 mm Cu, shows complex variation of a few per cent in the region of 1-5 mm, and below this falls rapidly" (22)

Calculations by Mayneord (23) have made it possible to determine, by a simple calculation, the integral dose for an irradiation of either the whole body or the trunk only. Tables have been drawn up which give the calculated average dose in the patient for different effective absorption coefficients of the radiation and for varying anteroposterior thickness of the trunk. The measured doses have been used to construct a graph showing the relationship between half-value layer and effective absorption coefficient. The inte-

gral dose for the irradiation may be found by a simple application of these data (23)

The integral dose involved in the use of Gilbert Scott techniques (27) has been briefly considered and, for the two techniques set out below, the following experimental results were obtained (22) when the beam was circular and of 60 cm diameter so as just to enclose the trunk

(a) 100 kv (const), filter 1.0 mm Al, HVL = 0.14 mm Cu, FSD 20 in. (51 cm) Integral dose per r on skin at the centre of field = 9,700 gram-roentgens

(b) 130 kv, filter 3 mm Al, HVL = 0.265 mm Cu, FSD 20 in. (51 cm) Integral dose per r on skin at the centre of the field = 12,400 gram-roentgens

#### INTEGRAL DOSE AND RADIATION EFFECTS

The quantitative estimation of radiobiological effects has always been a prob-

integral dose (radium teletherapy and protection, for example), much of the total energy may be absorbed at widely varying dosage rates, some at very low dosage rates. We may therefore expect that, for the same integral dose, the biological response under the latter conditions may be very different from that when the energy is absorbed at dosage rates of the order commonly used therapeutically.

As Mayneord and Clarkson have emphasised (22), the integral dose results of whole body irradiation seem to be of considerable significance in their relation to protection considerations. The Protection Regulations lay down a "tolerance dose" independent of wave length, but we have seen that integral dose varies with the quality of radiation, a result due to the combined physical and geometrical factors involved. It is not specifically stated whether the tolerance dose (about 1 r per week) is regarded as surface dose, average dose throughout the body, or dose over a small surface. In practice it seems to be taken as the dose at the site at which measurement is made, from Figure 6, therefore, for "tolerance" conditions, the integral dose is of the order of 55,000 gram-roentgens per r in the "deep-therapy" region and of the order of 10,000 for wave lengths such as are involved in diagnostic radiology. These values are quite large. In this same connection the increase of integral dose with decrease in distance of radium sources from the body already discussed (Fig. 5) should receive due consideration. "It seems that the study of integral dose will frequently reveal relationships not brought to light by a consideration of dose alone" (22).

#### SUMMARY

An account of the conception of integral dose is given and its possible importance is indicated.

The theoretical variation with wave length of the energy flux required to deliver a dose of one roentgen at the surface of a body (with and without back-scatter) is examined and expressed graphically.

The expression of total energy absorbed in terms of integral dose is described, and the units so far used for the measurement of integral dose are defined.

Methods that have been developed for integral dose determination are outlined for the various cases that arise in practice, namely, x-ray and gamma-ray beam therapy, radium therapy, whole-body and wide-field irradiation. Some account is given of the results obtained in these cases, and the significance of the results is discussed.

A description is given of the attempts made so far to relate integral dose and biological effect, and possible difficulties and limitations are indicated.

**ACKNOWLEDGMENTS** It gives me great pleasure to acknowledge the kindness of all those authors who so readily gave me permission to reproduce material from their papers, and of the editors of the *British Journal of Radiology*, who allowed me to reproduce the text figures from that journal.

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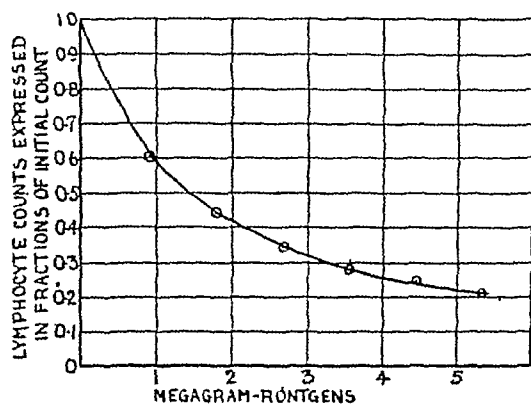


Fig 8 (Bush, 1)

Goodfellow's data (7), indicate that the behaviour of the lymphocytes during the treatment of breast cancer by interstitial and surface methods is of the same kind, although different in degree. These results fitted the curve obtained by Bush when the integral doses in the treatment of breast cancer were scaled down by a factor of 3.6. It is suggested (31) that the differences are due to differences in the parts and extent of the body irradiated and to the difference in the dosage rates involved.

The lymphocyte count appears to be the only feature of the blood count which shows any regular behaviour with respect to integral dose, and Ellis (6) has not found it possible to use even this for a similar study with x-rays.

Other objective phenomena that might be studied in relation to integral dose are (6) the corpuscular volume, colour index, sedimentation rate, and blood pressure, but Ellis (6) believes that none of these varies as readily with integral dose as do the lymphocytes. X-rays also reduce the ascorbic acid content of the blood (6), but whether the changes can be correlated with integral dose remains to be seen.

There are other *subjective* phenomena associated with x-ray treatment, such as malaise, nausea, vomiting, and headache, but these are all impossible to measure and to dissociate from the effects of local phenomena (6). With regard to integral dose and the general condition of the patient, Smithers (28) says that "determinations made on patients undergoing x-ray treatment for

carcinoma of the oesophagus have shown that, in this debilitated group, a dose of the order of 25 megagramme-r given to the thorax in six weeks is close to the limit," and that "some patients whose resistance is low have shown signs of serious constitutional effects when a dose of between 15 and 18 megagramme-r has been given in about 30 days."

#### GENERAL DISCUSSION

We have tried to trace the development of the concept of total energy absorption or integral dose and of its study in clinical practice and we have seen that even with the rather simplified idea of a gram roentgen as the unit of integral dose, considerable progress has been made. Before leaving the subject, however, we have thought it worth while to indicate some of the other factors that will need attention in future developments and some of the implications of these newer concepts.

The body so far has been considered as a homogeneous absorbing material of air-equivalent material. This assumption also made in most other dosage considerations, is considerably removed from the actual facts, and ultimately allowance will have to be made for this.

In considering integral doses in radiation therapy, especially comparatively, it is obvious that attention must also be given to the region irradiated. It is quite easy to imagine the same integral dose being given in the treatment of a thigh as of a neck, the effects on the patient, however, would be very different. It was for such reasons that Bush (1) and Wilson (31) confined their observations to groups of similar cases.

Another factor which would seem to be of considerable importance in integral dose problems, but which it has not been possible yet to take into account, is dosage rate. Upon this, biological responses of the kind we are interested in here are known to depend to a large degree (10), especially in the region of low dosage rates, where the recovery factor becomes of prime importance. In many problems of

# Osteopoikilosis Report of Two Cases<sup>1</sup>

MAJ M. C ARCHER, M.C , A.U S , and MAJ. K. W FOX, M.C , A.U S.

**R**ELATIVELY FEW cases of osteopoikilosis have been found in the available literature In view of the rarity of this congenital bone disease, the following two examples are recorded

**CASE I** An 18-year-old white soldier was first seen in the Orthopedic Clinic, complaining of pain in the left knee Since a definite diagnosis was not evident clinically, roentgen examination of the joint was requested This revealed the typical findings of osteopoikilosis The patient was therefore admitted to the Station Hospital, Camp Wolters, Texas, on Jan 27, 1945, for additional study

Complaints referable to the knee dated back to 1940, at which time the patient injured the joint while pole vaulting Two hours following the accident, his knee began to swell and he was obliged to stay in bed for approximately two days No roentgenograms were taken Ever since the injury, there had been mild pain deep within the joint whenever heavy manual labor was attempted Changes in weather were registered by the intensity of the pain, but there was no history of locking, catching, or recurrent swelling The patient stated that the knee frequently felt weak and unstable and that he did not trust it At the time of admission, he had completed 11 weeks of infantry training but had been unable to finish several marches because of knee discomfort He gave no history of any other joint affection nor of any unusual bone findings His occupation prior to induction, on Oct 21, 1944, was that of farmer, machinist, and worker in a meat-packing plant He had no unusual habits His 19-year old brother, who had recently been killed in a plane accident, was thought to have had tuberculosis of the left knee at one time, but apparently no roentgenograms had been taken One of the grandparents was said to have had brittle bones, with numerous fractures

The patient's past history revealed the usual childhood diseases measles, mumps, and scarlet fever In 1943, a tonsillectomy was done because of repeated sore throat In 1937, a fall from a bicycle resulted in a supracondylar fracture of the left elbow which was treated by reduction on two different occasions and immobilization in a sling for two months Venereal disease was denied both by name and symptoms

Physical examination showed the patient to be well developed and well nourished, 70 1/2 inches tall and weighing 160 pounds The skin, head, and neck were negative There was slight flaring of the

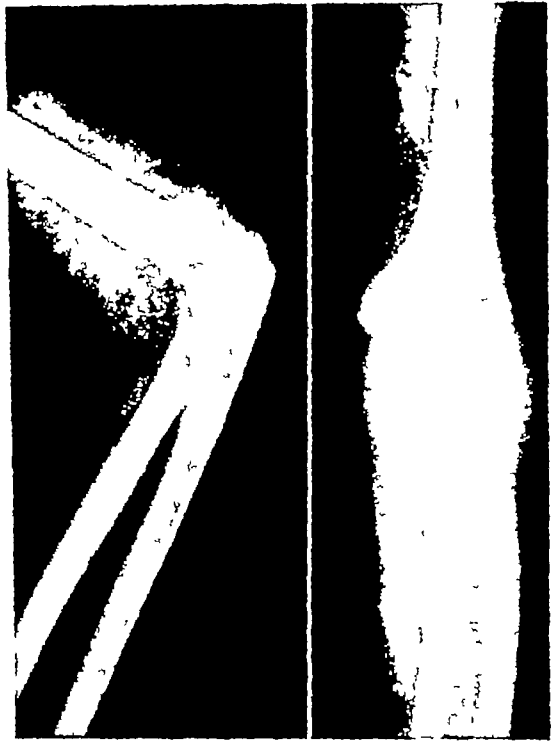


Fig 1 Case I Supracondylar fracture of the left elbow sustained in 1937 A few areas of condensation are present

left costal margin, but no rachitic rosary was felt The lungs and vascular system were normal, and the blood pressure was 100 systolic, 70 diastolic The abdomen, genito-urinary system, anus, rectum, and glandular system were found to be essentially normal No hernia was present The bones and joints were negative with the exception of slight tenderness over the femoral condyles of the left knee just inferior to the patella The contour of this joint was normal, and all motions were free, complete, and painless No grating was present and no effusion was noted Examination of the left elbow was entirely negative There was slight atrophy of the left quadriceps muscle The nervous system was normal

The laboratory findings were as follows

## Urinalysis

Specific gravity

1.012

Albumin

Negative

Sugar

Negative

Sedimentation rate

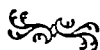
10 mm per hour

Fasting blood sugar

108 mg %

<sup>1</sup> Accepted for publication in October 1945.

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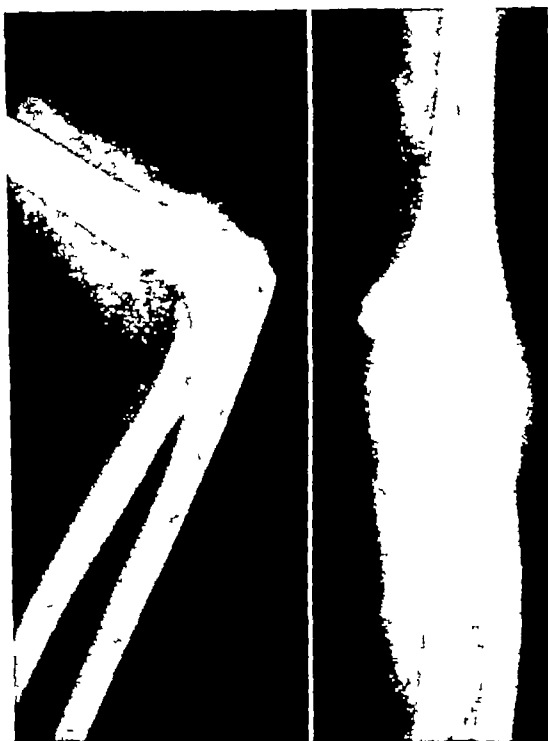


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Fig 3 Case I Right shoulder and both forearms



Fig 4 Case I Ankles and feet

<i>Blood phosphorus</i>	4.6 mg %	<i>Blood count</i>	
<i>Blood calcium</i>	14 mg %	Red blood cells	5,660,000-5,800,000
<i>Blood phosphatase</i>		Hemoglobin	104%-110%
Alkaline	1 Bodansky unit	White blood cells	12,500 -11,750
Acid	0.22 Shumowara-Jones - Reinhart unit	Neutrophils	67%-78%
<i>Blood Kahn test</i>	Negative	Lymphocytes	30%-19%
		Monocytes	1%-1%
		Eosinophils	2%-2%



Fig 2 Case I Right knee region and pelvis Spherical areas of condensation are clearly shown in the knee.



Fig. 6 Case II Left shoulder and pelvis

118 systolic, 62 diastolic. The abdomen was negative and no hernia was present. A drop of thick, yellowish pus expressed from the urethra was found upon examination to be negative for gonococci. The anus, rectum, and glandular system were normal. Examination of the bones and joints was clinically negative except for slight tenderness over the anterior part of the left shoulder. Findings relative to the muscular and nervous systems were also within normal limits.

The laboratory findings were as follows:

#### Urinalysis

Specific gravity	1.026
Albumin	Negative
Sugar	Negative
Microscopic	20-25 WBC per high power field
Sedimentation rate	16 mm. per hour
Fasting blood sugar	85 mg. %
Blood phosphorus	3.5 mg. %
Blood calcium	9.5 mg. %
Blood phosphatase	
Alkaline	2.6 Bodansky units
Acid	0.84 Shinowara Jones-Reinhart unit
Blood Kahn test	Negative
Blood count	
Red cell count	1,800,000
Hemoglobin	95%

White cell count	9,850
Neutrophils	61%
Lymphocytes	39%
Monocytes	None
Eosinophils	None
Basophils	None

Roentgen examination showed a preponderance of elongated and rod-shaped areas of condensation, the largest of which measured  $0.5 \times 5.0$  cm. These were best shown in the proximal thirds of the tibiae. There was no evidence of osteopoikilosis in the patellae. Otherwise, the distribution of the areas of condensation was the same as in Case I.

#### CONCLUSIONS

Two cases are reported in which osteopoikilosis was an incidental finding, apparently asymptomatic.

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Fig 5 Case II Left knee and left ankle, showing elongated and rod-shaped areas of condensation

X-ray examination revealed spotty bone formation of the following portions of the body: femora, patellae, tibiae, fibulae, tarsals, metatarsals, pelvis, humeri, ulnae, radii, carpals, and metacarpals. The areas of condensation were found in the cancellous portions of the ends of the long bones in the epiphyseal and diaphyseal regions. They were either spherical or elongated in shape (1). The majority, however, were spherical. They varied from 2 to 5 mm in diameter and were evenly distributed throughout the cancellous portions of the involved bones. They were well shown in the patellae, though some writers have found no evidence of the disease at that site. There was no evidence of osteopoikilosis in the skull, sternum, clavicles, ribs, or vertebrae.

In 1937, the patient had sustained a supracondylar fracture of the left elbow. The film taken at that time showed small areas of spotty bone formation, but the lesions were not so numerous as those found in the more recent films. This observation corroborates that of Holly (2), who found that the involved areas did not remain constant in size or number.

**CASE II** A 21-year-old-white soldier was initially seen in a dispensary in August 1945, complaining of lumbar backache. Roentgenograms of the lumbar region which were taken at that time were suggestive of osteopoikilosis. Additional films were therefore taken and the same type of lesion was found in other bones. The patient was subsequently admitted to the Station Hospital, Camp Wolters, Texas, on Aug 13, 1945, for additional study. Upon admission, he complained of pain and weakness of the right leg, a low-grade pain in the lumbar region, and intermittent pains in both shoulders.

The onset of symptoms dated back to March 1931, when the patient sustained a laceration of the leg when struck by a log hook. Ever since the accident, he had experienced episodes of weakness and pain in the involved leg, and because of this complaint was placed on a limited infantry training status. The lumbar backache dated back to a truck accident in 1938. The low-grade shoulder pains had been present as long as the patient could remember and he knew of no apparent cause. None of the involved joints had ever been definitely swollen and no roentgen studies had ever been made.

Prior to induction on May 21, 1945, the patient had been a farmer and lumberjack. He had no unusual habits. The family history was insignificant, except that one brother had died in 1918, at the age of 9, from tuberculosis of the spine. He was said to have been sick approximately three years and was finally subjected to operation. The paternal grandfather died supposedly from cancer of the bones of the hand. The patient recalled no history of any other member of the family having "spotted bone." He had had the usual childhood diseases: measles, mumps, whooping cough, and chickenpox, and in 1941 had a siege of bronchial pneumonia. In April 1945, he was treated by a brief course of intramuscular penicillin for acute gonorrheal urethritis.

Examination showed the patient to be well developed and well nourished, he weighed 154 pounds and was 69 inches in height. Except for a non-adherent, non-painful stellate scar, measuring 5 cm in diameter, on the medial aspect of the right leg, the skin was normal. Examination of ear, eye, nose and throat, neck, thorax, lungs, and vascular system showed nothing of significance. The heart size and sounds were normal, the blood pressure was

the kidneys, thyroid, thymus, brain, or lymphatic system. The pulmonary and the gastro-intestinal syndromes are, however, the most common.

Diagnosis is dependent upon the laboratory demonstration of the ova in the stool specimen, the appearance of the adult worm in the excreta following a vermifuge, or roentgen demonstration of the parasite in the alimentary canal.



Fig 3 The area shown in Fig 1 after the occurrence of spasm

#### CASE REPORT

A 27 year old soldier entered the hospital April 7, 1945, with a history of recurrent attacks of upper mid abdominal cramping pain associated with post-prandial regurgitation of food for the preceding month. The abdominal discomfort was transitory and irregular, with no relationship to the type of food ingested. There was no history of hemoptysis, hematemesis, melena, diarrhea, jaundice, or weight loss.

The patient has been in the Italian theater of war seventeen months and admitted occasionally partaking of unauthorized native food. No history of abdominal complaints prior to the onset of the present symptoms could be elicited.

The physical examination was essentially negative. No tenderness and no palpable masses were

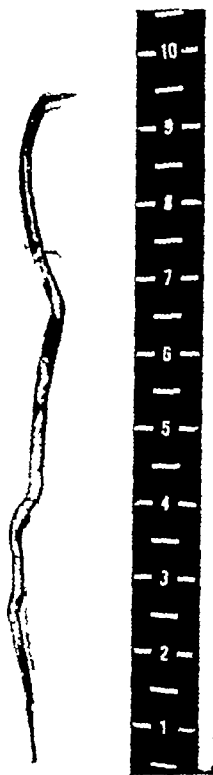


Fig 4 *Ascaris lumbricoides*, expelled after administration of a vermifuge

detected on examination of the abdomen. Because the clinical pattern did not coincide with that of any definite disease entity, the admission diagnosis was functional gastro-intestinal disease.

**Laboratory Findings** The red blood cell count was 4,400,000, white cells 8,950, hemoglobin 85 per cent. The differential count was eosinophils 2 per cent, stab forms 2 per cent, polymorphonuclears 54 per cent, lymphocytes 38 per cent, monocytes 4 per cent. The Kahn test was negative. Gastric analysis was within normal limits. Five stool specimens were negative for ova or parasites.

**X Ray Examination** A gastro-intestinal examination was done on April 8, 1945, and no organic lesion was demonstrable in the esophagus, stomach, or duodenum. During fluoroscopic observation of the small intestine, a filling defect with a configuration resembling a round worm, 15 to 20 cm in length and 5 mm in thickness, was detected in the jejunum (Figs 1 and 2). This area was obliterated in a few moments by the thick barium column, and shortly thereafter spasm of the small intestine occurred at this site (Fig 3). Several attempts were made, without success, to visualize the intestinal tract of the parasite following its ingestion of the barium meal. Following the radiographic demonstration of the parasite, efforts to isolate the ova or worms from stool specimens on five occasions were futile.

# Roentgen Diagnosis of Ascariasis in the Alimentary Tract<sup>1</sup>

LT COL D C WEIR, M.C., A U S

St Louis, Mo

*Ascaris lumbricoides* infestation occurs throughout the world in tropical and temperate regions, and its occurrence has been reported from arctic areas. Ascariasis is one of the most common helminthic

the lungs. After reaching the lungs, their itinerary is similar to that of the hookworm. The minute larvae penetrate the pulmonary capillaries, and gain entrance to the terminal alveoli, from which they



Figs 1 and 2. In Fig 1 the *Ascaris* is observed lying in the intestine prior to the onset of intestinal spasm. The U-shaped barium collection just below the site of the *Ascaris* is in the appendix. Fig 2 is a detail view of the parasite in the intestine.

parasitic diseases of man (1). It occurs predominantly in those sections where soil pollution is extensive or where human excrement is used as crop fertilizer. The embryonated ova are conveyed to the alimentary tract by unclean hands or contaminated food or water. After incubation in the intestine, the larvae are liberated and penetrate the intestinal mucosa to reach the mesenteric venules, whence they are carried by the venous circulation to the liver and subsequently through the right heart to

migrate up the bronchial tree to the epiglottis. They are swallowed by the patient, again lodging in the small intestine, and it is during this second sojourn in the gastro-intestinal tract that the larvae develop into the adult helminths.

A bronchitis or pneumonitis (2) with considerable hemorrhage is not an unlikely complication if a copious inoculation is received. Bizarre clinical manifestations are sometimes encountered when the larvae gain entrance to the systemic circulation through the left heart and involve

<sup>1</sup> Accepted for publication in November 1945.



# Symmetrical Renal Rotation About the Vertical Axis<sup>1</sup>

CAPT BENJAMIN R. VAN ZWALUWENBURG, M C, A U S, and MAJ LUCIEN M. PASCUCCI, M C, A U S

RETROPERITONEAL tumors frequently produce roentgenographic evidence of their presence by displacement of the kidneys and/or ureters or rotation of the kidneys. The types of renal rotation are summarized and illustrated by Weyrauch (J Urol 41: 877, 1939) as torsion about the vertical axis, about the anteroposterior axis, and about the horizontal axis (axis of the renal pelvis). He discusses the mechanisms of displacement and torsion by intrarenal and extrarenal retroperitoneal masses and presents (among others) two cases which show a pure rotation of the kidney about the vertical axis, so as to direct the pelvis of the kidney anteriorly. In each patient a retroperitoneal extra-renal mass was found. In his discussion Weyrauch comments on the possibility of confusing acquired rotation about the vertical axis with congenital failure of rotation from the fetal position in which the pelvis is directed anteriorly. A patient with acquired bilateral and symmetrical renal rotation about the vertical axis was recently observed at this hospital.

A colonel, age 48, complained of abdominal discomfort and distention, belching, weakness, and marked weight loss. He appeared cachectic and presented a firm fixed tumor somewhat larger than half a grapefruit in the mid-line of the abdomen. Moderate ascites was present. Detailed laboratory studies were non contributory. Retrograde pyelography (Fig 1) demonstrated a rotation of both kidneys about the longitudinal axis so that the pelves projected anteriorly. The symmetry of this rotation suggested a bilateral congenital failure of rotation of the kidneys rather than displacement or torsion by a tumor, but the presence of a palpable mass and lateral displacement of both upper ureters prompted a clinical diagnosis of retroperitoneal tumor. Exploratory laparotomy revealed a hard, nodular retroperitoneal mass, measuring 16 cm in greatest diameter, lying in the mid-line at about the 2nd lumbar level. It was fixed to retroperitoneal structures posteriorly and could not be removed. The histologic diagnosis was malignant follicular lymphoma.



Fig 1 Retrograde pyelogram demonstrating lateral displacement of both kidneys and proximal third of ureters. It also shows bilateral symmetrical renal rotation with pelves directed anteriorly.

In the differential diagnosis between torsion of the kidneys by a retroperitoneal mass and congenital failure of rotation in this case the presence of a mid-line abdominal mass was the most obvious and practical differential point. In addition to the rotation of the kidneys, the anteroposterior projection shows the upper ureters to be moderately curved (due to lateral displacement by the tumor) in contrast to the relatively straight appearance of the ureter found in congenital failure of rotation. (Lateral or oblique projections might have demonstrated anterior displacement of the kidney and upper ureter by a retroperitoneal mass.)

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<sup>1</sup> From the Department of Radiology, O'Reilly General Hospital, Springfield, Mo. Accepted in October 1945.

*Treatment* On April 12, Caprokol (hexylresorcinol crystoids) therapy was initiated. The patient was given 1.0 gm (total) in the morning on a fasting stomach, followed two hours later by a saline purge. Eighteen hours later, a female *Ascaris* ten inches in length (Fig 4) was recovered from the stool. The patient became asymptomatic and was discharged to duty April 14, 1945.

#### COMMENT

Ascariasis is endemic in the Italian theater, where soil pollution is common and human excrement is the fertilizer of preference. The soldier undoubtedly contracted the infestation in an Italian home or restaurant. It is relatively unusual for a patient to harbor round worms in the intestinal tract and exhibit persistently negative stool specimens. In our institution, we have had numerous cases of ascariasis which were diagnosed in the laboratory with subsequent roentgenologic confirmation, but only one case was diagnosed by roentgen studies with failure to confirm the diagnosis by repeated careful stool examinations.

The roentgen findings are diagnostic, but are not infrequently overlooked. The diagnosis of round worm infestation is dependent on careful scrutiny of the small intestine during fluoroscopic examination. Thorough examination of the upper small gut cannot be too strongly stressed. The characteristic shadow is apparent for only a very short period, after which it is en-

tirely obliterated by the descent of larger amounts of the barium meal. The almost invariable negativity of subsequent routine radiographs is thus readily explained. Spasm of the small intestine, previously mentioned as occurring at the location of the parasite, may be present during the routine filming.

The chest film in the case recorded here was essentially negative, but infiltrative pulmonary lesions are not infrequently produced during the passage of the larvae from the capillaries into the alveoli. The lesions are the result of hemorrhage and allergic cellular reaction which may simulate pulmonary tuberculosis, atypical pneumonia, or any other patchy, infiltrative pneumonic process.

#### SUMMARY

A discussion of round worm infestation is presented and a case of ascariasis which was diagnosed roentgenographically is recorded.

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latter produce differences in the energy transformed at any given depth. The quantitative relations between the wave length and the effect on cells are not completely worked out. Measurements in a phantom fail to take into account the differences in absorption and scattering in different types of tissue encountered in practice. Wave length changes induced by scattering may introduce significant variations in the amount of energy released at any point below the surface. The use of the depth dose as a quantitative measurement is justified only when these limitations are kept in mind.

A wealth of information is available upon the effect of radiation on various types of cells *in vivo* and *in vitro*. This information, however, is as yet imperfectly related to the effect upon tissues, normal and abnormal, in the patient. The great complexity of the problem accounts for the slow accumulation of scientific data. No cancer or benign mixture of tissues contains a single cell type. The simplest neoplasm is made up of cells of varying growth rates and characteristics, each of which will respond differently to radiation. An even more extensive variety of cell types is presented by the tumor bed. All of these cells will react differently to the same quantity of radiation. Some will be killed outright, some will be destroyed after a latent period, some will show alterations in mitosis, some will degenerate, and some will differentiate. The rate of change will vary from cell to cell. Successful radiation therapy, on a scientific basis, must take all these variations into account.

The general constitutional effects which are known to follow irradiation are also imperfectly understood. So far, no quantitative relationship has been established between constitutional effects and dosage.

Radiation therapy has made great strides. The introduction of the roentgen, increasing knowledge of filtration, and the employment of higher voltages have produced gradual improvement in statistical results. These results, however, have all been interpreted empirically, and atten-

tion has been directed toward their improvement by trying different wave lengths, different voltages, different time-spacing of the dose, without sufficient regard to the complex individual variations in responsiveness of the disease treated and the reparative potentials inherent in the individual.

Progress is being made toward more accurate cytological and biological information upon which to formulate a scientific dosage system for radiation. The concept and measurement of the integral or volume dose (1) should greatly advance knowledge of constitutional over-all factors and should assist in the selection of appropriate technics for specific conditions. Preliminary steps have also been taken in the cytological analysis (2) of tumors and tumor beds, which should eventually lead to a solid scientific foundation on which to base selection of wave length, fractionation, and total dosage. Constructive work has been started in untangling the complex question of distribution of energy released at points below the surface (3), with a more definite relation to actual conditions than the approximations now in use. Progress along these lines will be hastened if the limitations of present dosage methods are kept in mind.

SYDNEY J. HAWLEY, M.D.

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# EDITORIAL

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## The Dose of Radiation

Webster defines the word "dose" as "the measured quantity of medicine to be taken at one time or in a given period of time, a definite quantity or portion, usually small, of anything regarded as having a remedial or beneficial influence" "Dosage" is defined as "the administration of medicine in doses, especially in graded doses, according to age, etc" Years of usage have confirmed a definite concept associated with these words An ounce of castor oil may confidently be expected, with minor variations, to produce a definite result Five or ten grains of aspirin may be relied upon to relieve certain symptoms These medications are measured in simple units which are related to the effect The pharmacological action of most drugs in common use is well understood

With radiation therapy, these conditions do not apply Yet the terms "dose" and "dosage" are used analogously, referring to an amount of radiant energy directed at the patient in a period of time, with the object of palliation or even with the hope of cure A somewhat different significance attaches to the compound "depth-dose," wherein the term dose in its customary sense is justified neither by the conditions of irradiation nor by the knowledge of action of the "medication" Clarification of the meaning behind these terms is one of the steps most urgently needed for the further improvement of radiation therapy

The physical aspects of dosage measurement are far in advance of the pharmacological and cytological The general acceptance of the roentgen, even by dermatologists, has produced a real advance toward a scientific understanding of radiation therapy This unit is a convenient

measure of the energy capacity of a beam, it has made possible duplication of beams of similar energy potentials and has thrown much light on the problem of back-scatter and its important relationship to energy absorption in the body Because of an assumed analogy to such units of dosage as grains, grams, or cubic centimeters, there is a strong tendency to regard the amount of radiation expressed in r in the same category, for example, as that of digitals expressed in grains This is misleading It is not yet possible to say that the average adult dose of radiation is 200 r, 2,000 r, 20,000 r, or any other specific amount The literature contains countless references to basal-cell carcinomas cured by 6,000 r and an equal number in which such amounts or even larger ones have failed These variations in results arise from profound physical, pharmacological, and cytological factors which are imperfectly understood The danger is that this ignorance will be forgotten in the ease of expression of dosage in terms of the roentgen

The term "depth-dose," as usually employed, signifies the amount of radiation at a certain point below the surface and it, too, is expressed in roentgens, the figure used being obtained from isodose curves made from phantom measurements This is the best method at present to express in a quantitative sort of way the idea of the radiation applied to a deep-seated tumor But it is at best only an approximation Small variations in the half-value layer of the primary beam will introduce larger variations in the energy released within the body Although the roentgen is independent of wave length and although no specificity of tissue effect has been shown for any wave length, differences in the

latter produce differences in the energy transformed at any given depth. The quantitative relations between the wave length and the effect on cells are not completely worked out. Measurements in a phantom fail to take into account the differences in absorption and scattering in different types of tissue encountered in practice. Wave length changes induced by scattering may introduce significant variations in the amount of energy released at any point below the surface. The use of the depth dose as a quantitative measurement is justified only when these limitations are kept in mind.

A wealth of information is available upon the effect of radiation on various types of cells *in vivo* and *in vitro*. This information, however, is as yet imperfectly related to the effect upon tissues, normal and abnormal, in the patient. The great complexity of the problem accounts for the slow accumulation of scientific data. No cancer or benign mixture of tissues contains a single cell type. The simplest neoplasm is made up of cells of varying growth rates and characteristics, each of which will respond differently to radiation. An even more extensive variety of cell types is presented by the tumor bed. All of these cells will react differently to the same quantity of radiation. Some will be killed outright, some will be destroyed after a latent period, some will show alterations in mitosis, some will degenerate, and some will differentiate. The rate of change will vary from cell to cell. Successful radiation therapy, on a scientific basis, must take all these variations into account.

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- MAYNEORD, W V. Energy Absorption. Mathematical Theory of Integral Dose. *Brit J Radiol* 17 359-367, December 1944, 18 12-19, January 1945.
- WILSON, C W. Energy Absorption and Integral Dose in X-ray and Radium Therapy. A Review. *Radiology* 47 263-278, September 1946.
- 2 KOLLER, P C, AND SMITHERS, D W. Cytological Analysis of the Response of Malignant Tumors to Irradiation as an Approach to a Biological Basis for Dosage in Radiotherapy. *Brit J Radiol* 19 89-100, March 1946.
- GLUCKSMAN, A, AND SPEAR, F G. Qualitative and Quantitative Histological Examination of Biopsy Material from Patients Treated by Radiation for Carcinoma of the Cervix Uteri. *Brit J Radiol* 18 313-322, October 1945.
- 3 SPIERS, F W. Effective Atomic Number and Energy Absorption in Tissues. *Brit J Radiol* 19 52-63 February 1946.

## REFRESHER COURSES POST-GRADUATE INSTRUCTION

A series of Refresher Courses will be presented at the time of the meeting of the Radiological Society of North America, at the Palmer House, Chicago, Dec 1-6, 1946

These courses of post-graduate instruction will be given from 2 to 5 P M and 7 to 9 P M on Sunday, Dec 1, and from 8.30 to 10 A M daily thereafter during the meeting. No meetings will be scheduled for these hours, and the courses have been so arranged that those interested in a particular subject may enroll in a related series, as far as possible.

Admission will be by ticket only, and reservations will be made in the order in which applications are received. Non-members will be charged \$2.00 for each course, up to a maximum of \$5.00 for the entire series. Reserve officers still on active duty, residents

and fellows in radiology will be exempt from these charges.

Read the description of the courses, noting particularly the days upon which they are offered, study the Plan of Presentation and select carefully your choice for each day, as the number attending each course will be limited. If the directions listed on the Plan of Presentation and Instructions for Enrollment are observed, errors will be avoided.

If the Refresher Courses are not filled by the time of the meeting, tickets will be available at the registration desk, Sunday, Dec 1, and thereafter.

It may be necessary to alter or revise some of the courses and to change some of the instructors. We shall, however, adhere as closely as possible to the choices made.

### Course No 1 Sunday, 3-5 P M

#### Clinical, Pathological, and Roentgenologic Findings in Generalized Bone Diseases

JOHN D. CAMP, M.D., and DAVID G. PUGH, M.D.  
Mayo Clinic, Rochester, Minn

Changes in bone due to certain metabolic, nutritional, and endocrine disorders will be considered. The roentgenologic aspect of these malacic diseases will be emphasized, but relevant clinical and pathological findings will also be discussed.

### Course No 2 Sunday, 2-3.30 P M

#### Differential Diagnosis of Abdominal Tumors

SAMUEL BROWN, M.D.  
Cincinnati, Ohio

A discussion of the roentgen diagnosis of extra-gastro-intestinal tumors, based upon the underlying anatomical principle that the stomach and bowels are, relatively speaking, freely movable and bear a constant relationship to the adjacent organs. In the examination of a large number of abdominal tumors more or less characteristic alterations were often found in the position, shape, and contour of the stomach and bowels, thus making it possible to determine with a high degree of accuracy the origin of a new growth.

### Course No 3 Sunday, 3.30-5 P M

#### Intravaginal Radiation Therapy

W. WALTER WASSON, M.D.  
Denver, Colo

This is a presentation of the indications and contraindications for intravaginal radiation therapy. The technic and dosage will be given for both x-ray

and radium. Another method for the application of radium will be offered for consideration. There will be a discussion of the results of these methods of treatment together with delayed reactions.

### Course No 4 Sunday, 7-9 P M

#### 1 Use of Radioactive Isotopes in Diagnosis and Therapy

B. V. A. LOW-BEER, M.D.  
University of California  
San Francisco, Calif.

#### 2 Use of Radioactive Phosphorus in the Treatment of the Blood Dyscrasias

EDWARD H. REINHARD, M.D.  
Washington University  
St. Louis, Mo

Discussion of present stage of development and use of radioactive isotopes in diagnosis and therapy. Dr. Reinhard will also give a brief discussion of radioactive iodine. Results to date will be summarized.

### Course No 5 Sunday, 7-9 P M

#### Film Reading Session

MERRILL C. SOSMAN, M.D.  
Boston, Mass  
Presiding

JOHN D. CAMP, M.D., Rochester, Minn  
L. HENRY GARLAND, M.D., San Francisco, Calif.

Those attending this course are invited to bring roentgenograms of unusually interesting or difficult cases for discussion. Only cases with proved diagnoses should be submitted. Cases can be presented from films, but standard size lantern slides would be helpful for presentation to a larger audience.

**Course No 6 Monday, 8 30-10 A M****Roentgenological Classification of the Pneumonias with Special Reference to the Structures Involved****L R SANTE, M D****St Louis, Mo**

In recent years many causes have been found for pneumonia other than the pneumococcus. Many of these pneumonias have been described as atypical pneumonias of unknown etiology. The etiologic agents for these unusual forms are so multiple and varied that they may cause confusion to the radiologist. To clarify the situation, a comparative study of the roentgen manifestations of the various types of pneumonia with the pathological pictures which they produce has been undertaken.

being considered on the first day and the second three on the second day )

- 1 Roentgen methods and materials
  - (a) Evaluation of types of examination
  - (b) Uses and limitation of roentgen procedures
  - (c) Dangers of urography
- 2 The normal urinary tract
  - (a) Physiology
  - (b) Anatomy
  - (c) Roentgen interpretation
- 3 Anomalies and variants
  - (a) Embryology of some of the common anomalies
  - (b) Role of anomalies in development of disease
  - (c) Late results of anomalies
- 4 Roentgen interpretation of genito-urinary tract disease
  - (a) Stones
  - (b) Infections
  - (c) Tumors
  - (d) Cysts
  - (e) Miscellaneous
- 5 Value of urography in disease primarily outside of the urinary tract
  - (a) Aneurysms
  - (b) Retroperitoneal tumors and infections
- 6 Cystoscopy and urethrography

**Course No 7 Monday, 8 30-10 A M**  
**Classification, Diagnosis, and Treatment of Cancer of the Skin****BERNARD P WIDMANN, M D****Philadelphia, Penna**

Discussion of diagnosis, classification, how and why cancer of the skin should be treated

**Course No 8 Monday, 8 30-10 A M****Diagnosis of Diseases of the Gallbladder, Pancreas, and Mesentery****BYRL R KIRKLIN, M D****Mayo Clinic  
Rochester, Minn**

- 1 Cholecystography by the oral method with emphasis on the necessity of care in administering dye and interpretation of the cholecystographic response. Criteria of distinction between normal and abnormal response will be presented with illustrative cholecystograms
- 2 (a) Disclosure of tumors of the pancreas with aid of opaque ingesta  
(b) Roentgenographic demonstration of pancreatic calculi  
(c) Differential diagnostic points, including mesenteric pathology

**Courses Nos 10 and 15 Monday and Tuesday, 8 30-10 A M****Roentgenologic Diagnosis and Treatment of Diseases of the Brain and Spinal Cord****Staff of the University of Illinois College of Medicine****T J WACHOWSKI, M D****Presiding****Historical Aspects and Consideration of Skull Fractures**  
**A J PETERSEN, M D (by invitation)****Plain Film Skull Findings in Neurological Surgery**  
**ERIC OLDBERG, M D (by invitation)****Skull Diagnostic Procedures by Contrast Media**  
**PERCIVAL BAILEY, M D (by invitation)****The Spine in Neurological Surgery**  
**PAUL C BUCY, M D (by invitation)****Radiation Therapy of Diseases of the Nervous System**  
**ROGER T HARVEY, M D (by invitation)****(This course requires two days )**

Brief historical review of the roentgenologic methods used in neurologic diagnosis. Technical procedures with and without contrast media. Interpretation of roentgenograms with correlation of clinical and pathological findings. Discussion of how, when, and why radiation therapy should be given.

Discussion period at each session

**Courses Nos 9 and 14 Monday and Tuesday, 8 30-10 A M****Roentgenology of the Urinary Tract****ROBERT P BARDEN, M D, GEORGE W CHAMBERLIN, M D, B S, Sc D, and P BOLAND HUGHES, M D**  
**(by invitation)****University of Pennsylvania  
Philadelphia, Penna.**

(Course requires two days the first three items

# Plan of Presentation

SUNDAY 2-5 P M	MONDAY 8 30-10 A M	TUESDAY 8 30-10 A M
<p>1 Clinical, Pathological, and Roentgenologic Findings in Generalized Bone Diseases</p> <p>3-5 P M</p> <p>John D Camp, M D David G Pugh, M D</p>	<p>6 Roentgenological Classification of the Pneumonias with Special Reference to the Structures Involved</p> <p>L. R. Sante, M D</p>	<p>11 Clinical Pathological Significance and Differential Diagnosis of Segmental Collapse of the Lungs</p> <p>Laurence L. Robbins, M.D</p>
<p>2. Differential Diagnosis of Abdominal Tumors</p> <p>2-3 30 P M</p> <p>Samuel Brown, M.D</p>	<p>7 Classification, Diagnosis, and Treatment of Cancer of the Skin</p> <p>Bernard P Widmann, M.D</p>	<p>12 Practical Problems in X ray Dosage Measurements</p> <p>J L. Weatherwax, M S</p>
<p>3 Intravaginal Radiation Therapy</p> <p>3 30-5 P M</p> <p>W Walter Wasson, M.D</p>	<p>8 Diagnosis of Diseases of the Gallbladder, Pancreas, and Mesentery</p> <p>Byrl R Kirklin, M D</p>	<p>13 Diseases of the Esophagus, Stomach, and Duodenum</p> <p>Panel Discussion (<i>Continued Wednesday</i>)</p> <p>F H Squire, M D James B Eyerly, M.D H C Breuhaus M D G M Hass, M D John M. Dorsey, M D E H Fell, M D</p>
<p>7-9 P M</p> <p>4. Use of Radioactive Isotopes in Diagnosis and Therapy</p> <p>B V A Low Beer, M D</p> <p>Use of Radioactive Phosphorus in Treatment of Blood Dyscrasias</p> <p>Edward H Reinhard, M D</p>	<p>9 Roentgenology of the Urinary Tract (<i>Continued Tuesday</i>)</p> <p>Robert P Barden, M D Geo W Chamberlin, M.D P Boland Hughes M D</p>	<p>14 Roentganology of the Urinary Tract (<i>Continued from Monday</i>)</p>
<p>5 Film Reading Session</p> <p>Merrill C Sosman, M D John D Camp, M D L Henry Garland, M D</p>	<p>10 Roentgenologic Diagnosis and Treatment of Diseases of the Brain and Spinal Cord (<i>Continued Tuesday</i>)</p> <p>T J Wachowski, M D A. J Petersen, M.D Eric Oldberg M.D Percival Bailey M D Paul C Bucy, M D Roger T Harvey, M.D</p>	<p>15 Roentgenologic Diagnosis and Treatment of Diseases of the Brain and Spinal Cord (<i>Continued from Monday</i>)</p>

# Plan of Presentation

WEDNESDAY 8 30-10 A M	THURSDAY 8 30-10 A M	FRIDAY 8 30-10 A M
<p>16 Classification, Interpretation, and Standards of Miniature Chest Films Herman E Hilleboe, M D Russell H Morgan, M D David M Gould, M D</p>	<p>21 Clinical and Roentgenologic Aspects of Bronchography L W Paul, M D</p>	<p>26 Cancer of the Male Genital Tract Milton Friedman, M D</p>
<p>17 Practical Problems in Radium Dosage Measurements Edith H Quimby Sc D</p>	<p>22 Classification and Treatment of Carcinoma of the Female Genital Tract A N Arneson, M D</p>	<p>27 Classification, Diagnosis, and Treatment of Benign Lesions of the Female Genital Tract James A Corscaden, M.D</p>
<p>18 Diseases of the Esophagus, Stomach, and Duodenum Panel Discussion (<i>Continued from Tuesday</i>)</p>	<p>23 Roentgenologic Findings in the Study of the Small Intestine Robert P Ball, M D</p>	<p>28 Roentgenologic Diagnosis of Diseases of the Colon David G Pugh, M D</p>
<p>19 Skeletal Disorders with Occasional Discussion of the Differential Diagnosis between Arthritis and Attrition (<i>Continued Thursday</i>) L Henry Garland, M D</p>	<p>24 Skeletal Disorders with Occasional Discussion of the Differential Diagnosis between Arthritis and Attrition (<i>Continued from Wednesday</i>)</p>	<p>29 Roentgenologic Manifestations of Acute Abdominal Diseases Leo G Rigler, M D</p>
<p>20 When, Why, and How Should Carcinoma of the Breast Be Treated? Herbert E Schmitz, M D</p>	<p>25 Classification, Diagnosis, and Evaluation of the Different Forms of Treatment of Cancer of the Oral Cavity, Pharynx, and Larynx (<i>Continued Friday</i>) Juan A. del Regato, M D</p>	<p>30 Classification, Diagnosis, and Evaluation of the Different Forms of Treatment of Cancer of the Oral Cavity, Pharynx, and Larynx (<i>Continued from Thursday</i>)</p>

### Course No 11 Tuesday, 8 30-10 A M

#### Clinical Pathological Significance and Differential Diagnosis of Segmental Collapse of the Lungs

LAURENCE L. ROBBINS, M D (by invitation)  
Massachusetts General Hospital  
Boston, Mass

The significant factors in the roentgen diagnosis of collapse of a lung, a lobe, and the various segments thereof will be presented. Certain structures seen in the normal chest as they pertain to collapse and the major technical requirements will be brought out. It is known that accurate roentgen diagnosis depends on recognition of the fundamental process as seen on the films in addition to certain clinical observations, the important points will be emphasized.

### Course No 12 Tuesday, 8 30-10 A M

#### Practical Problems in X-Ray Dosage Measurements

J. L. WEATHERWAX, M S, Physicist  
American Oncologic Hospital  
Philadelphia, Penna

- 1 Effect of kilovoltage, milliamperage, filtration, and focal-skin distance on the radiation roentgen output of an x-ray machine as measured in air
- 2 Effect of quality of radiation, size of field, and depth of underlying tissue on back-scatter
- 3 Effect of quality of radiation, size of field, and focal skin distance on penetration of the radiation into the tissue, or depth dose
- 4 Isodose charts. Determination of radiation intensity in roentgens, and quality in half-value layer and effective wave length
- 5 Scattering and total absorption of photons in the tissue
- 6 Discussion of the record sheet as recommended by Standardization Committee of the Radiological Society of North America

### Courses Nos 13 and 18 Tuesday and Wednesday, 8 30-10 A M

#### Diseases of the Esophagus, Stomach, and Duodenum Panel Discussion

FAY H. SQUIRE, M D  
Presiding

JAMES B. EYERLY, M D, H. C. BREUHAUS, M D,  
JOHN M. DORSEY, M D, E. H. FELL, M D, and G. M.  
HASS, M D

Staff of Presbyterian Hospital, University of Illinois  
(Rush) Medical School, Chicago, Illinois  
(By Invitation)

- 1 Medical Aspects of Diseases of the Esophagus, Stomach, and Duodenum  
JAMES B. EYERLY, M D

2. Gastroscopic Findings in Diseases of the Stomach  
H. C. BREUHAUS, M D

3 Radiological Examination of the Stomach and Duodenum, Demonstrating Pathological Changes  
F. H. SQUIRE, M D

4 Pathological Anatomy of Esophagus, Stomach, and Duodenum

G. M. HASS, M D

5 Surgery of the Esophagus  
JOHN M. DORSEY, M D

6 Surgery of the Stomach and Duodenum  
E. H. FELL, M D

### Course No 16 Wednesday, 8 30-10 A M.

#### Classification, Interpretation, and Standards of Miniature Chest Films

HERMAN E. HILLEBOE, M D, Medical Director, Chief, Tuberculosis Control Division, U S Public Health Service, Washington, D C (Bethesda Station)  
Presiding

Assisted by  
RUSSELL H. MORGAN, M D  
DAVID MARSHALL GOULD, M D

This course will include the procedures used by the Tuberculosis Control Division in demonstrations on mass radiography surveys. Sample films will be shown demonstrating the various types of lesions encountered, the difficulty in interpretation of various tuberculous lesions will be pointed out, the codes used in classifying x-ray lesions and the percentage of error in small film interpretations will be discussed.

### Course No 17 Wednesday, 8 30-10 A M

#### Practical Problems in Radium Dosage Measurements

EDITH H. QUIMBY, Sc D, Physicist  
Columbia University  
New York, N Y

The development of dosage units for radium therapy will be traced briefly. Various charts and tables for determination of dosage in roentgens will be presented, and precautions regarding their use discussed. Most of the period will be devoted to working out practical problems. (An exhibit on radium dosage calculation will probably be presented.)

### Courses Nos 19 and 24 Wednesday and Thursday, 8 30-10 A M

#### Skeletal Disorders with Occasional Discussion of the Differential Diagnosis between Arthritis and Attrition

L. HENRY GARLAND, M D  
San Francisco, Calif

(This course requires two days.)

# REFRESHER SERIES

## THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

*December 1 to 6, 1946*

PALMER HOUSE  
CHICAGO, ILLINOIS

### FILL OUT THE FOLLOWING

Print or type your name

Street Address

City

State

Check

Member Radiological Society of North America ☐

Non-Member ☐

Tear out and mail to C. Edgar Virden, M.D., Chairman, Refresher Course Committee, 700 Professional Building, 1103 Grand Ave., Kansas City 6, Mo.

Fill out, also, the enrollment diagram on the reverse side of this page

# REFRESHER SERIES

## INSTRUCTIONS FOR ENROLLMENT

Read the accompanying description of the courses and study the plan of presentation. It is important that you register early, the number admitted to each course will be limited by the seating capacity of the room. Reservations will be made in the order of the receipt of request.

Non-members will be charged \$2 00 for each refresher course up to a maximum of \$5 00 for the entire series, payable, at the time of application, to the Radiological Society of North America. Non-member fees should accompany the request for reservations.

## PLEASE INDICATE YOUR CHOICE

	COURSE NUMBER	LECTURER
SUNDAY 2-5 P M		
SUNDAY 7-9 P M		
MONDAY 8 30-10 A M		
TUESDAY 8 30-10 A M		
WEDNESDAY 8 30-10 A M		
THURSDAY 8 30-10 A M		
FRIDAY 8 30-10 A M		



The incidence, classification, pathological changes, and roentgen diagnosis of certain types of skeletal disorders, notably those involving joints, will be considered. The terminology used by different physicians for identical lesions will be reviewed. The value of the newer roentgenologic technics will be discussed.

**Course No 20 Wednesday, 8 30-10 A M**  
**When, Why, and How Should Carcinoma of the Breast Be Treated?**

HERBERT E. SCHMITZ, M D  
 Mercy Institute of Radiation Therapy  
 Chicago, Ill

Discussion of grouping of breast cases and selection of treatment.

- (a) Those treated with radical surgery alone
- (b) Those treated by simple mastectomy and biopsy plus irradiation
- (c) Those treated by irradiation only
- (d) Observations and end-results in each group

**Course No 21 Thursday, 8 30-10 A M**  
**Clinical and Roentgenologic Aspects of Bronchography**

L. W. PAUL, M D  
 University of Wisconsin  
 Madison, Wis

Advances in thoracic surgery have placed new demands upon roentgenologists for the accurate interpretation and localization of intrathoracic lesions. The present course will cover the clinical and roentgenologic aspects of bronchography and will include a discussion of the indications and contraindications for the procedure. A description of the technical aspects will be given with reference to anesthesia, introduction of the contrast substance, and radiographic procedure. A brief survey of bronchial anatomy and nomenclature will be presented, followed by a demonstration of bronchograms showing the value and limitations of the method in the diagnosis of intrathoracic diseases.

**Course No 22 Thursday, 8 30-10 A M**  
**Classification and Treatment of Carcinoma of the Female Genital Tract**

A. N. ARNESON, M D  
 St. Louis, Mo

The classification of cervical cancer will be discussed as well as the gross appearance of different lesions and the relation of those findings to treatment. An attempt will be made to discuss treatment on the basis of arrangement of radium and the dose per source rather than specify total amounts of radiation that might be employed. Similar procedures will be applied to vaginal carcinoma.

Preoperative irradiation, including the use of radium, will be discussed in considering the treatment of corpus cancer as well as the use of radiation alone in patients not suited to hysterectomy. Clinical results will be presented in a small group of patients with corpus cancer treated with multiple capsules of radium five or more years ago.

**Course No 23 Thursday, 8 30-10 A M**  
**Roentgenologic Findings in the Study of the Small Intestine**

ROBERT P. BALL, M D  
 Presbyterian Hospital  
 New York, N Y

The session will include a discussion of the normal anatomy and the basic principles of intestinal movements. The roentgenographic findings in disturbances in motility and mucosal pattern of the small intestine, associated with primary and secondary nutritional deficiency states, will be illustrated and discussed.

**Courses Nos 25 and 30 Thursday and Friday, 8 30-10 A M**

**Classification, Diagnosis, and Evaluation of the Different Forms of Treatment in Cancer of the Oral Cavity, Pharynx, and Larynx**

JUAN A. del REGATO, M D  
 The Ellis Fischel State Cancer Hospital, Columbia, Mo

(This course requires two days.)

An anatomical classification of these tumors is necessary to an understanding and critical appraisal of the literature and for the presentation of reports that will bear comparison, as well as for a judicious choice of treatment and the establishment of a prognosis. The classification allows a better discussion of the problems of differential diagnosis of cancer arising in the various anatomical points of origin. The most pertinent points of diagnosis, including removal of specimens for biopsy, aspiration biopsy, and value of roentgenograms will be discussed.

A major part of the course will be devoted to the evaluation of the relative merits of surgery, radium therapy, and roentgen therapy in the treatment of the different anatomical entities, with a special discussion of the indications and contraindications for prophylactic treatment of cervical metastases.

**Course No 26 Friday, 8 30-10 A M**  
**Cancer of the Male Genital Tract**

MILTON FRIEDMAN, M D  
 Department of Radiology, New York University  
 New York, N Y

Correlation of clinical, pathological, and roentgenological findings in cancer of the male genital

tract, with discussion of when, why, and how it should be treated

**Course No 27 Friday, 8 30-10 A M**

**Classification, Diagnosis, and Treatment of Benign Lesions of the Female Genital Tract**

**JAMES A. CORSCADEN, M.D** (by invitation)  
New York, N Y

Miomata of the uterus are composed of tissue which requires no treatment. They become clinically significant because of size, symptoms, and changes in the tumor mass. Uterine bleeding is the principal symptom. Its nature should always be established by a diagnostic curettage, whatever treatment is carried out. Treatment of fibroids is either by observation, by operation, or by induction of the menopause by irradiation of the ovaries. The choice of treatment depends upon its effect on symptoms and on the local lesion, its efficacy as a prophylactic measure, and upon the associated injury to the patient.

Endometrial and cervical mucous polyps are treated by excision.

Ovarian enlargements are either (1) dysfunctional cysts, (2) endometriosis, or (3) neoplasms. Neoplasms should always be removed. Endometriosis may be treated conservatively but is often operated upon. Dysfunctional cysts rarely require treatment. Their removal seldom affects symptoms.

**Course No 28 Friday, 8 30-10 A M**

**Roentgenologic Diagnosis of Diseases of the Colon**

**DAVID G. PUGH, M.D**  
Mayo Clinic  
Rochester, Minn

The conduct of the examination of the large intestine will be described and the criteria for the diagnosis of the lesions more frequently encountered there will be discussed.

**Course No 29 Friday, 8 30-10 A M**

**Roentgenologic Manifestations of Acute Abdominal Diseases**

**LEO G. RIGLER, M.D**  
University of Minnesota  
Minneapolis, Minn

1 Roentgen technic in acute abdominal disorders. Special technical procedures are necessary in the handling of patients. Variations from the usual technic in the examination of the abdomen, the difficulties, and special procedures necessary will be detailed.

2 Indications for roentgen examination in the acute abdominal disorders. The various acute processes in the abdomen in which roentgen examination is of great assistance in establishing either the diagnosis or aiding in determining the extent and nature of the process will be presented.

3 Analysis of the scout film of the abdomen.  
(a) The normal appearance of the roentgenogram of the abdomen without contrast medium. The soft tissue shadows, the appearance of the gastrointestinal tract with and without preparation and under varying conditions will be demonstrated.

(b) The abnormal roentgenogram without contrast medium. A discussion of the physiologic and pathologic factors in the production of changes in the abdomen will be undertaken. An analysis of the various findings which may be obtained with different types of acute abdominal disorders and their differential diagnosis will be presented.

Demonstrations will be given of the x-ray findings

iii

- (1) Peritonitis
- (2) Intra-abdominal abscess
- (3) Small intestinal obstruction
- (4) Large intestinal obstruction

4 Value of x-ray examination in the acute abdominal disorders. An estimation of the reliability of the various x-ray signs and their contribution toward the practical handling of the patient will be presented.



### Alexander Berkeley Moore

1883-1946

Alexander B. Moore, who died in the Emergency Hospital, Washington, D. C., on March 9, 1946, was born at Aldie, Virginia, in 1883. He obtained his medical degree at the University of Virginia in 1907 and practised for about a year at The Plains, Virginia. In 1909 he entered the Radiological Department of the Mayo Clinic and continued there for more than twenty years. During the First World War he was on leave of absence from the Clinic and served with the A. E. F. in France, at first as Radiological Consultant with the First Army and later as Chief Radiological Consultant with the Second Army, with headquarters at Toul. In 1930 he joined the Radiological Clinic of Drs. Groover, Christie, and Merritt and for the remainder of his life was Chief of the Radiological Department of the Emergency Hospital in Washington, D. C.

Dr. Moore was a member of the Radiological Society of North America, of the American Roentgen Ray Society, which he served as President in 1930-31, and of the Medical Society of the District of Columbia. He was a fellow of the American Medical Association and of the American College of Physicians.

"Sandy," as he was known to his friends everywhere, had a great capacity for friendship. He had a genuine liking for people and an attractive personality and facility of expression which drew others to him. He will be sadly missed for his kindly human and companionable qualities, and among those closely associated with him in practice for his unusual and outstanding ability as a roentgenological diagnostician.

ARTHUR C. CHRISTIE

## ANNOUNCEMENTS AND BOOK REVIEWS

### RADIOLOGICAL SOCIETY OF NORTH AMERICA

The Thirty-second Annual Meeting of the Radiological Society of North America will be held Dec 1 to Dec 6 at the Palmer House, Chicago. The series of Refresher Courses, which has come to constitute so important a feature of the Annual Meeting, is outlined elsewhere in this issue. The program, now in course of preparation, will appear in the October number

president. The other new officers are Dr Edwin C Ernst of St Louis, Vice-President, Dr Warren W Furey of Chicago, Treasurer, Dr Raymond C Beeler of Indianapolis and Dr Edgar C Virden of Kansas City, Mo, members of the Board of Chancellors. Dr Ralph Bromer of Bryn Mawr, Penna., becomes a member of the Board of Chancellors representing the American Roentgen Ray Society, Dr Sydney J Hawley of Seattle representing the Radiological Society of North America, and Dr



*Kaufman & Fabry Photo*

Chicago, Ill. Here the Thirty-second Annual Meeting of the Radiological Society of North America will be held, Dec 1-6, 1946

### AMERICAN RADIUM SOCIETY

The newly elected officers for the American Radium Society are as follows: Charles L Martin, M D, Dallas, President, A N Arneson, M D, St Louis, President-elect, Maurice Lenz, M D, New York, First Vice-President, William S MacComb, M D, New York, Second Vice-President, Hugh F Hare, M D, Boston, Secretary, Leland R Cowan, M D, Salt Lake City, Treasurer. The members of the Executive Committee are Frederick W O'Brien, M D, Boston, Hayes E Martin, M D, New York, William E Costolow, M D, Los Angeles

### AMERICAN COLLEGE OF RADIOLOGY

At the annual meeting of the American College of Radiology, held in San Francisco, June 29, Dr Edward H Skinner of Kansas City, Mo, was elected

Douglas Quick of New York representing the American Radium Society

### PITTSBURGH ROENTGEN SOCIETY

At the last business meeting of the Pittsburgh Roentgen Society the following officers were elected for the coming year: Harold W Jacob, M D, President, Wm T Rice, M D, Vice-President, Lester M J Freedman, M D, Secretary-Treasurer

### AMERICAN COLLEGE OF PHYSICIANS

The Twenty eighth Annual Session of the American College of Physicians will be held in Chicago Ill, April 28 to May 2, 1947. Dr David P Barr, New York, President of the College, will be in charge of the program of General Sessions and Lectures

Dr LeRoy H Sloan, Chicago, has been appointed General Chairman, and will be in charge of the program of Hospital Clinics and Panels. Mr Edward R Loveland, Executive Secretary of the College, 4200 Pine St., Philadelphia 4, will have charge of the general management of the session and the technical exhibits.

### CANCER CONTROL REPORT

A special committee of the National Advisory Cancer Council appointed in November 1944 by Dr Thomas Parran, Surgeon General of the U S Public Health Service, has recently issued its report, with recommendations looking to an accelerated cancer control program. The report, which appears in the April issue of the *Journal of the National Cancer Institute*, recommends more comprehensive and better integrated courses in cancer at medical schools, an increase in the number of centers prepared to give postgraduate training in cancer, and the continuation and expansion of the various kinds of cancer-education activities for practicing physicians that have been conducted in a number of communities. It is recommended further that the National Cancer Institute aid in the development of strategically located cancer centers, that it expand its own research work and extend assistance to State health departments and other agencies in developing adequate cancer services.

The members of the committee responsible for the report are Dr George M Smith, Yale University School of Medicine, Dr Frank Adair, Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York City, and Dr Sherwood Moore, Mallinckrodt Institute of Radiology, St Louis, Mo.

### Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

**X-RAYS IN PRACTICE** By WAYNE T SPROULL, PH D, Physicist, Research Division, General Motors Corporation. A volume of 615 pages, with numerous illustrations. Published by McGraw-Hill Book Co., Inc., New York 18, N Y. Price \$6 00.

**PRÉCIS DE RADIO-DIAGNOSTIC** By P VAN PÉE, Professor, University of Liège. A volume of 382 pages, with 276 illustrations. Published by Masson & Cie, Editeurs, Paris, 1944.

**JOURNAL OF THE HISTORY OF MEDICINE AND ALLIED SCIENCES**, Volume I, No 1, January 1946. GEORGE ROSEN, Editor. Published quarterly by Henry Schuman, New York.

### Book Reviews

**THE TRAUMATIC DEFORMITIES AND DISABILITIES OF THE UPPER EXTREMITY** By ARTHUR STEINDLER, M.D., F A C S, Professor and Head of the Department of Orthopedic Surgery, The State University of Iowa, in collaboration with JOHN LOUIS MARXER, M.D., Associate, Orthopedic Department, The State University of Iowa. A volume of 515 pages with 1048 illustrations. Published by Charles C Thomas, Springfield, Ill., 1946. Price \$10 00.

The vast amount of material on trauma of the upper extremity, as stated in the foreword of this volume by Steindler and Marxer, precludes the utilization of any one man's clinical experience. The authors, therefore, have found it necessary at times to call on others for contributions.

The volume is an excellent reference book for the trained orthopedist. The subject matter is presented in a logical, well outlined manner. An early chapter deals in a general way with the production of deformities resulting from trauma. In the discussion of the individual deformities, corrective measures are presented which include physiotherapy and plastic and reconstructive surgery. A large number of conditions are described, with detailed accounts of various treatments which are accepted. Accurate descriptions of the lesions are given with the authors' opinion of the corrective measures outlined in the light of their own very considerable experience.

Careful attention is given to the anatomy of the part involved, as well as to the pitfalls to be avoided in correction. Pertinent case reports with excellent illustrations are included.

For one unfamiliar with any particular operation or procedure, this book serves as a starting point for reading. A complete bibliography is supplied for further reference. The volume is a worthy successor to Dr Steindler's *Operative Orthopaedics*.

# RADIOLOGICAL SOCIETIES OF NORTH AMERICA

*Editor's Note*—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich

## UNITED STATES

*Radiological Society of North America*—Secretary, D. S. Childs, M.D., 607 Medical Arts Bldg, Syracuse 2, N.Y.  
*American Roentgen Ray Society*—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa  
*American College of Radiology*—Secretary, Mac F. Cahal, 20 N. Wacker Dr., Chicago 6, Ill.  
*Section on Radiology, American Medical Association*—Secretary, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio

## ARKANSAS

*Arkansas Radiological Society*—Secretary, Fred Hames, M.D., Pine Bluff. Meets every three months and annually at meeting of State Medical Society

## CALIFORNIA

*California Medical Association, Section on Radiology*—Secretary, D. R. MacColl, M.D., 2007 Wilshire Blvd., Los Angeles 5  
*Los Angeles County Medical Association, Radiological Section*—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building  
*Pacific Roentgen Society*—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with California Medical Association  
*San Diego Roentgen Society*—Secretary, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego, Calif. Meets first Wednesday of each month  
*San Francisco Radiological Society*—Secretary, Joseph Levitt, M.D., 518 Sutter St., San Francisco 2. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year in Lane Hall, Stanford University Hospital, and second six months in Toland Hall, University of California Hospital

## COLORADO

*Denver Radiological Club*—Secretary, A. Page Jackson, Jr., M.D., 304 Republic Bldg., Denver 2. Meetings third Friday of each month, Denver Athletic Club

## CONNECTICUT

*Connecticut State Medical Society, Section on Radiology*—Secretary, Max Cluman, M.D., 242 Trumbull St., Hartford 3. Meetings bi-monthly, second Thursday

## FLORIDA

*Florida Radiological Society*—Secretary-Treasurer Maxey Dell, Jr., M.D., 333 West Main St., S. Gainesville

## GEORGIA

*Georgia Radiological Society*—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St. N.E. Atlanta 3. Meets in November and at the annual meeting of State Medical Association

## ILLINOIS

*Chicago Roentgen Society*—Secretary Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12. Meets at the Palmer House, second Thursday of October, November, January, February, March and April

*Illinois Radiological Society*—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement

*Illinois State Medical Society, Section on Radiology*—Secretary, Frank S. Hussey, M.D., 250 East Superior St., Chicago 11

## INDIANA

*The Indiana Roentgen Society*—Secretary-Treasurer, J. A. Campbell, M.D., Indiana University Hospitals, Indianapolis 7. Annual meeting in May

## IOWA

*The Iowa X-ray Club*—Secretary, Arthur W. Erskine, M.D., 328 Higley Building, Cedar Rapids. Meets during annual session of Iowa State Medical Society

## KENTUCKY

*Kentucky Radiological Society*—Secretary-Treasurer, Sydney E. Johnson, M.D., 101 W. Chestnut St., Louisville

## LOUISIANA

*Louisiana Radiological Society*—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society

*Orleans Parish Radiological Society*—Secretary, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month

*Shreveport Radiological Club*—Secretary, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday, 7:30 P.M.

## MARYLAND

*Baltimore City Medical Society, Radiological Section*—Secretary, Charles N. Davidson, M.D., 101 West Read St., Baltimore 1

## MICHIGAN

*Detroit X-ray and Radium Society*—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms

## MINNESOTA

*Minnesota Radiological Society*—Secretary, A. T. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 28. Meetings quarterly

## MISSOURI

*Radiological Society of Greater Kansas City*—Secretary, John W. Walker, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Friday of each month

*St. Louis Society of Radiologists*—Secretary, Edwin C. Ernst, M.D., 100 Beaumont Medical Bldg. Meets on fourth Wednesday of each month, October to May

## NEBRASKA

*Nebraska Radiological Society*—Secretary-Treasurer, Donald H. Breit, M.D., University of Nebraska Hospital, Omaha 5. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln

## NEW ENGLAND

*New England Roentgen Ray Society*—Secretary-Treasurer, George Levene, M.D., Massachusetts Memorial

Hospitals, Boston, Mass Meets monthly on third Friday at Boston Medical Library

#### NEW HAMPSHIRE

*New Hampshire Roentgen Society*—Secretary-Treasurer, Richard C Batt, M D, St Louis Hospital, Berlin

#### NEW JERSEY

*Radiological Society of New Jersey*—Secretary, W H Seward, M D, Orange Memorial Hospital, Orange Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called

#### NEW YORK

*Associated Radiologists of New York, Inc*—Secretary, William J Francis, M D, East Rockaway, L I

*Brooklyn Roentgen Ray Society*—Secretary-Treasurer, Abraham H Levy, M D, 1354 Carroll St, Bklyn 13 Meets fourth Tuesday of every month, October to April

*Buffalo Radiological Society*—Secretary-Treasurer, Mario C Gian, M D, 610 Niagara St, Buffalo 1 Meetings second Monday evening each month, October to May, inclusive

*Central New York Roentgen Society*—Secretary-Treasurer, Carlton F Potter, M D, 425 Waverly Ave, Syracuse 10 Meetings in January, May, and October

*Long Island Radiological Society*—Secretary, Marcus Wiener, M D, 1430 48th St, Brooklyn 19 Meetings fourth Thursday evening each month at Kings County Medical Bldg

*New York Roentgen Society*—Secretary, Wm Snow, M D, 941 Park Ave, New York 28

*Rochester Roentgen-Ray Society*—Secretary, Murray P George, M D, 260 Crittenden Blvd, Rochester 7 Meets at Strong Memorial Hospital, third Monday, September through May

#### NORTH CAROLINA

*Radiological Society of North Carolina*—Secretary-Treasurer, Major I Fleming, M D, 404 Falls Road, Rocky Mount Meets in May and October

#### NORTH DAKOTA

*North Dakota Radiological Society*—Secretary, Charles Heilman, M D, 1338 Second St, N, Fargo

#### OHIO

*Ohio Radiological Society*—Secretary, Henry Snow, M D, 1001 Reibold Bldg Dayton 2 Next meeting at annual meeting of the Ohio State Medical Association

*Central Ohio Radiological Society*—Secretary, Hugh A Baldwin, 347 E State St, Columbus

*Cleveland Radiological Society*—Secretary-Treasurer, Carroll C Dundon, M D 11311 Shaker Blvd, Cleveland 4 Meetings at 6 30 P M on fourth Monday of each month from October to April, inclusive

*Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists)*—Secretary-Treasurer Samuel Brown M D 707 Race St, Cincinnati 2 Meetings held third Tuesday of each month

#### PENNSYLVANIA

*Pennsylvania Radiological Society*—Secretary Treasurer, L E Wurster, M D 418 Pine St, Williamsport 8

*Philadelphia Roentgen Ray Society*—Secretary Calvin I Stewart M D Jefferson Hospital, Philadelphia 7 Meets first Thursday of each month at 8 00 P M from October to May in Thomson Hall 21 S 22d St

*Pittsburgh Roentgen Society*—Secretary-Treasurer, Lester M J Freedman, M D, 415 Highland Bldg, Pittsburgh 6 Meets second Wednesday of each month at 6 30 P M, October to May, inclusive

#### ROCKY MOUNTAIN STATES

*Rocky Mountain Radiological Society*—Secretary, A M Popma, M D, 220 N First St, Boise, Idaho

#### SOUTH CAROLINA

*South Carolina X-ray Society*—Secretary-Treasurer, Robert B Taft, M D, 103 Rutledge Ave, Charleston 16

#### TENNESSEE

*Memphis Roentgen Club*—Meetings second Tuesday of each month at University Center

*Tennessee Radiological Society*—Secretary-Treasurer, J Marsh Frère, M D, 707 Walnut St., Chattanooga Meets annually with State Medical Society in April

#### TEXAS

*Dallas-Fort Worth Roentgen Study Club*—Secretary, X R Hyde, M D, Medical Arts Bldg, Fort Worth 2 Meetings on third Monday of each month, in Dallas in the odd months and in Fort Worth in the even months

*Texas Radiological Society*—Secretary-Treasurer, R P O'Bannon, M D, 650 Fifth Ave, Fort Worth 4

#### UTAH

*Utah State Radiological Society*—Secretary-Treasurer, M Lowry Allen, M D, Judge Bldg, Salt Lake City 1 Meets third Wednesday, January, March, May, September, November

#### VIRGINIA

*Virginia Radiological Society*—Secretary, E Latan Flanagan, M D, 215 Medical Arts Bldg, Richmond 19

#### WASHINGTON

*Washington State Radiological Society*—Secretary-Treasurer, Thomas Carlile, M D, 1115 Terry Ave, Seattle Meetings fourth Monday of each month, October through May, at College Club, Seattle

#### WISCONSIN

*Milwaukee Roentgen Ray Society*—Secretary-Treasurer, C A H Fortier, M D, 231 W Wisconsin Ave, Milwaukee 3 Meets monthly on second Monday at the University Club

*Radiological Section of the Wisconsin State Medical Society*—Secretary, S R Beatty, M D, 185 Hazel St, Oshkosh Two-day meeting in May and one day at annual meeting of State Medical Society in September

*University of Wisconsin Radiological Conference*—Meets first and third Thursdays 4 to 5 P M, September to May, inclusive, Room 301, Service Memorial Institute, 426 N Charter St, Madison 6

#### CANADA

*Canadian Association of Radiologists*—Honorary Secretary-Treasurer, J W McKay, M D, 1620 Cedar Ave, Montreal

*La Societe Canadienne-Francaise d'Electrologie et de Radiologie Medicales*—General Secretary, Origene Dufresne M D, Institut du Radium, Montreal Meets on third Saturday of each month

#### CUBA

*Sociedad de Radiología y Fisioterapia de Cuba*—Offices in Hospital Mercedes Havana Meets monthly

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## THE HEAD AND NECK

Radiological Aspects of Intracranial Pneumocephalus. D C Eaglesham Brit J Radiol 18 335-343, November 1945

Pneumocephalus, an abnormal collection of air within the skull or external to it, but not including surgical emphysema of the face nor minute amounts of air associated with lacerations, is also referred to as pneumocranium, pneumatocele, and arocele. The author makes a distinction between such collections and abscesses containing gas-producing organisms. The recognition of the condition is important in connection with skull fractures involving the nasal sinuses and mastoids, particularly with leakage of cerebrospinal fluid. The present observations are based on 22 cases treated from 1942 to 1945.

Pneumocephalus may be classified etiologically as traumatic or non-traumatic and according to location as extracranial or intracranial. Intracranial pneumocephalus is of the following types

- Extradural
- Subdural
- Subarachnoid
- Ventricular
- Extraventricular
- Cortical
- Cisternal
- Intracerebral

Mixed forms also occur

The commonest causes of pneumocephalus are fractures through the frontal, ethmoid, or sphenoid sinuses and the mastoid in the order given. Non-traumatic pneumocephalus is due in most instances to erosion of the intracranial surface of one of the sinuses by a tumor or infectious process.

Pneumocephalus is usually discovered within the first few days after an injury, though it has been known to develop after an interval of three years.

The radiographic appearance depends upon the location. Extradural pneumocephalus is rare. The gas is relatively small in amount and fixed in position. The subdural variety is common. Here the gas is free to move about and may outline the tentorium or the falx. Small quantities in the occipital or frontal areas are usually seen as a thin crescent with the concavity next to the brain. With larger quantities the surface of the brain may be visualized almost an inch from the inner table and a fluid level may be seen in appropriate projections. Subdural gas may simulate an intracerebral collection, but in the latter case the gas is fixed. Subarachnoid pneumocephalus presents features similar to encephalograms. The cisterns, cortical spaces, and ventricles may be outlined, and the gas may shift with changes in posture. Intracerebral collections of gas are most frequently seen extending upward from the floor of the anterior fossa or backward from the anterior wall close to the intracranial surface of the ethmoid or frontal sinus on one side. The midline is not usually crossed in this variety, but there may be bilateral lesions.

Conditions requiring differential diagnosis are scalp or bony defects, diploic vessel markings, gas-producing

cerebral abscess, porencephaly, intracranial lipomata, air accidentally introduced, as during lumbar puncture, and artefacts. The differential points for most of these conditions are obvious. Gas-producing abscesses, as a rule, are remote from the sinuses or mastoids, often show multiple gas pockets, produce a greater space-occupying effect on the ventricles and pineal body, do not usually show gas in the subarachnoid or subdural spaces, and do not appear suddenly nor increase in size rapidly. The differentiation of porencephaly may be difficult. Pneumocephalus tends to shift the ventricles to the opposite side, the gas is near a sinus or mastoid and it persists longer.

Stereoscopic views are best if they can be obtained. When they cannot, single views in two or three planes are advised. At least one view should be taken with the beam horizontal to reveal more clearly a fluid level. Special studies of the sinuses or mastoids may be advisable to demonstrate the source of the pneumocephalus.

In 15 of the author's 22 cases the pneumocephalus was demonstrated on the first examination or within four days. In the other 7 no gas was demonstrated until one to six weeks had passed. One case was extradural, 6 subdural, 4 cisternal or cortical subarachnoid, 1 ventricular subarachnoid, 4 intracerebral, and 4 combined types. Cerebrospinal leakage occurred in 13 instances. Meningitis developed in 4 patients. Fractures through the frontal, ethmoid, or sphenoid sinuses or mastoids were responsible for the condition in 21 cases. The other was secondary to a depressed fracture. One death occurred. Most of the patients were not followed long enough to determine the final outcome.

SYDNEY J. HAWLEY, M.D.

The So-Called Fifth and Sixth Cerebral Ventricle. A Clinical and Roentgenographic Study and Case Report. S J Silbermann Am J Roentgenol 54 503-511, November 1945

The *cavum of the septum pellucidum* is usually referred to as a cystic or hydropic enlargement of the potential space between the leaves of the septum pellucidum, which, lying in close apposition but separated from each other, form the medial partition of each anterior horn and adjacent portion of the body of the lateral ventricle and, simultaneously, the lateral boundary of the fifth ventricle. Caudally to the *cavum* of the septum pellucidum, and approximately in the same plane, lies the *cyst of Verga*, occupying the space between the under surface of the corpus callosum and the top of the psalterium. These anomalous ventricles—the so-called fifth and sixth—coexist and, in most instances also coalesce. They are usually connected through various openings with the third and lateral ventricles. There is a conspicuous absence of choroid plexus in their walls.

Cysts of the fifth and sixth ventricle are divided into two groups, the communicating and the non-communicating, the latter being subdivided into the primary and the acquired variety. Both variants of the closed type may give rise to clinical syndromes by blocking the foramina of the ventricles and producing internal hydrocephalus or by direct pressure upon adjacent solid neural structures. The differentiation be-

tween the closed and open type is easily made by careful air studies of the intracranial contents. Neither the mental nor the neurological signs are in any way specific. The intermittency of the clinical signs and the long duration are worthy of consideration.

A correct diagnosis can be made only with air studies. In the open type, the usually coexisting fifth and sixth ventricles communicate with each other and appear as one long, comma-shaped shadow on the lateral view. The closed type of cyst of the cavum of the septum pellucidum causes separation and bulging of the leaves of the septum toward the lumen of the anterior horns, while the closed cyst of Verga produces signs of displacement, often associated with production of internal hydrocephalus. A twenty-four-hour, forty-eight-hour, or even later roentgenogram after the introduction of air into the ventricles should be taken, since normally cysts of the closed types may be re-opened during the alteration of the intracranial pressure following the drainage of the cerebrospinal fluid. Retention of air in these cysts is suggestive of a ball-valve mechanism governing the communicating system between them and the regular ventricular system. A report of a fairly typical case is given.

CLARENCE E. WEAVER, M.D.

**Neoplasms of Both Maxillary Sinuses.** Meyer D. Berger. *Arch Otolaryng* 42: 397-403, November-December 1945.

A case of cancerous involvement of both maxillary sinuses in a 62-year old patient is presented. The neoplasms were separate and distinct entities, the second growth developing while the patient was under observation for the first. Electrosurgery with post-operative roentgen therapy was employed in both instances. Roentgenograms approximately seven months following the first and eight months after the second operation showed relatively good aeration of both antra. There was no clinical evidence of neoplasm or cervical metastasis at that time. Roentgenograms are reproduced.

A general discussion of the diagnosis and therapy of antral neoplasms follows the case presentation. Roentgen studies of the antrum may show an alteration of density that obliterates the air cavity, an opacity which may be due to neoplasm, polypoid, hyperplasia, exudate, or any combination of these processes. Although the roentgenograms can demonstrate the extent of the involvement, they generally cannot define the pathologic entity without supporting clinical and physical findings. Evidence of bone destruction often means an advanced stage of cancer.

## THE CHEST

**Atypical Pneumonia at an Air Base in India During the Winter of 1944-45.** Joseph H. Hafkenschiel. *Mil Surgeon* 97: 377-380, November 1945.

Twenty-two cases of atypical pneumonia which occurred at an air base in India are of particular interest because of the explosiveness of the outbreak of the disease following the arrival of a group of new personnel from the United States. The onset of symptoms, roentgen findings, and the course of the disease were essentially the same as described by others, although the cases were milder than those occurring in military camps in the continental limits.

**Some Observations on Primary Atypical Pneumonia.** Jacob Grossman. *Arch Int Med* 76: 328-334, November-December 1945.

A group of 45 cases of atypical pneumonia appearing during the first half of 1944 in Italy is described and compared with series previously reported. A comprehensive bibliography is appended.

**Diagnosis of Loeffler's Syndrome. Transient Lung Infiltration with Eosinophilia.** Elvin E. Gottdiener. *New York State J Med* 45: 2179-2182, Oct 15, 1945.

Loeffler's syndrome is characterized by transient eosinophilic infiltrations of the lung and eosinophilia in allergic individuals, especially asthmatics. The pulmonary infiltrations are usually homogeneous and may be unilateral or bilateral. Roentgenologically, they may appear as nodules, multiple cysts, extensive irregular shadows, peribronchial infiltrations fanning out from the hilus, or small infiltrations in the peripheral lung fields. Pleural effusion, when present, is most often small in amount and rapidly absorbed. A characteristic feature is the rapid resolution of the roentgen findings, which ordinarily persist from three to eight days, occasionally up to three weeks. Plate-like infiltrations may be observed before final resolution occurs. In the differential diagnosis, tuberculosis, virus pneumonia, lobar pneumonia, pulmonary infarct, and even Boeck's sarcoid must be considered.

The mechanism producing the infiltration is considered to be an "allergic edema," similar to urticaria, involving the alveoli in the sensitized or hyperergic lung. In the non-atopic individual, such hypersensitivity may represent allergic reaction to infection, such as tuberculosis, parasitic infestation, tetanus, and chronic sinusitis. In certain instances, the syndrome may represent evidence of a general vascular allergy which may result in panarteritis and polyserositis. A small number of fatalities have been reported.

Two case reports illustrate the differential diagnosis of Loeffler's syndrome, atypical pneumonia, and tuberculosis.

LESTER M. J. FRIEDMAN, M.D.

**Observations on Loeffler's Syndrome. Report of Four Cases.** H. Wallace Blanton. *Virginia M Monthly* 72: 473-479, November 1945.

The author reviews the literature on Loeffler's syndrome—pulmonary infiltration with an increased percentage of eosinophils in the blood stream—and records 4 cases. All of the patients gave a history of asthma or hay fever. In 3 cases, epinephrine injected subcutaneously led to temporary disappearance of the pulmonary shadows. The author regards this as confirming his assumption that he was dealing with an allergic reaction due to a localized edema comparable to angioneurotic edema and attributable to a hyper-permeability of the capillaries. He believes it to be an original observation, not previously recorded in the literature. In other types of the disease the cause may be a bacterial allergen or a parasite acting as an allergen. In such cases sympathomimetic drugs are without effect.

Other features which have received inadequate notice in the literature are the presence of a familial factor, observed in 2 of the author's cases, the frequency of asthma as a precursor of the syndrome, and a metallic taste in the sputum.

J. E. WHITELEATHER, M.D.

**Loeffler's Syndrome Report of a Case with Pathologic Examination of the Lungs.** E C Bayley, D O Lindberg, and Archie H Baggenstoss Arch Path. 40. 376-381, November-December 1945

A fatal case of Loeffler's syndrome is reported. The patient, a 59-year-old woman, was admitted to a sanatorium on July 3, 1944, with severe cough, breathlessness, and anorexia, she had lost about 60 pounds in weight. Roentgenograms of the chest revealed shadows of varying size, shape, and density in both upper lobes. The sedimentation rate (Cutler method) was 24 mm in one hour. The white blood cell count was 12,550, with 35 per cent eosinophils. Tests for tuberculosis were negative. The patient's condition improved with intravenous sodium iodide, and roentgenograms of the chest on July 30 and Aug 3 showed a bilateral regression of the lesions, ruling out the possibility of tuberculosis or neoplasm of the lung. When she was discharged, on Sept 11, only a few residual areas of abnormal density were visible roentgenologically. The patient failed to report for further sodium iodide therapy and monthly roentgenograms as instructed. On Dec. 21, she became suddenly ill, with substernal discomfort and severe, progressive dyspnea. Cyanosis became progressively worse, and generalized edema supervened. Death occurred in five days.

The outstanding features in the postmortem examination were the large numbers of eosinophilic leukocytes in the pneumonic exudate, the advanced organization of the exudate, with fibrosis and giant cells, the presence of peculiar granulomatous lesions, and necrotizing arteritis and phlebitis. The clearing of the pulmonary lesions demonstrated roentgenologically in this case suggests that regression of the lesions does occur but that this does not indicate complete resolution.

**Miliary Carcinosis of the Lungs Secondary to Primary Cancer of the Gastro-Intestinal Tract** Gordon J Culver Am J Roentgenol 54 474-482, November 1945

Miliary carcinosis of the lungs secondary to cancer of the gastro-intestinal tract, biliary tract, and pancreas is not common. This condition requires blood stream dissemination of tumor cells to the right heart. This may occur in two ways (1) through the regional lymph nodes and then to the thoracic duct, whence tumor cell emboli may pass to the left subclavian vein, to the left innominate, to the superior vena cava, and then to the right heart, from which a massive blood stream dissemination to the lungs may occur, (2) through invasion of the liver and hepatic veins, whence tumor cell emboli may enter the venous circulation and pass directly to the right heart and then to the pulmonary fields.

The lesions are evenly and diffusely distributed throughout the lung fields. The various lesions are not of homogeneous density but appear as soft mottled areas with fuzzy, poorly defined margins. They are unusually small and variable in size. They may later become confluent. Hilar node involvement may or may not be present. Miliary tuberculosis and silicosis must be considered in the differential diagnosis.

The lack of physical findings in the chest in miliary carcinosis is noteworthy. This may serve as an aid in the diagnosis. The history and clinical course are also helpful in ruling out tuberculosis and silicosis.

Four case reports are given and roentgenograms furnished to illustrate the pulmonary lesions described.

CLARENCE E WEAVER, M D

**Two Cases of Anterior Mediastinal Abscess.** Michael Aronovitch and Arthur M Vineberg Canad. M A J 53 455-458, November 1945

Anatomically, there is little reason for the formation of abscesses in the anterior mediastinum. It contains a few lymph nodes, some loose areolar tissue, and the remains of the thymus. A substernal thyroid may bulge into it and it may be the site of dermoid cysts and teratomas. Direct infection of the anterior mediastinum occurs from perforating wounds of the anterior chest. In Hare's collection of 115 cases reported in 1889, trauma was the most frequent cause of suppuration. Ravitch (Arch Surg 47 250, 1943) reported a case following intrasternal blood transfusion. In such cases of direct antecedent trauma the diagnosis would be suspected. In many cases the cause of suppuration is less obvious. Keefer's work indicates that tuberculosis, syphilis, and actinomycosis are the most common causes of anterior mediastinitis. The anatomical contents and boundaries of the anterior mediastinum would lead one to suspect that infections of the mediastinal nodes, infections at the lung roots, and contiguous pericardial or pericardiopleural inflammations are the most common causes of anterior mediastinal abscess, excluding trauma.

The symptoms and signs are variable and do not often point to a definite diagnosis. Constitutional symptoms and signs of suppuration are present. Localizing signs may be entirely lacking or confusing. There is usually a complaint of chest pain, which need not be retrosternal but may be on either side or referred to the base of the neck. The abscess may tend to point to one side or the other, and local reddening and bulging may appear in the interspace. If the abscess becomes large, there may be complaints of substernal oppression, with evidence of pressure on the heart, great vessels, and trachea. If the enlargement has been sudden, symptoms may suggest acute coronary occlusion or acute pericardial effusion. The x ray is invaluable in diagnosis, as it will usually rule out the confusing possibility of a pericardial effusion. A lateral film should always be taken when there are general signs of suppuration and chest pain. If the posterior border of the sternum is carefully inspected, the abscesses can be located. Definite and final diagnosis can then be established by aspiration. Surgery is the only treatment.

Two cases of anterior mediastinal abscess are presented by the authors with five reproductions of x ray films. The abscesses are well shown in the lateral view in each case. The authors stress the fact that lateral films of the chest at the onset of symptoms would have led to earlier diagnosis.

HUGH A O'NEILL, M D

**Pulmonary Stenosis with Intact Interventricular Septum. Report of Eleven Cases.** James H Currens, Thomas D Kinney, and Paul D White. Am Heart J 30 491-510, November 1945

Maude Abbott (Atlas of Congenital Heart Disease, Am Heart Assoc, 1936) found that among 1,000 cases of congenital heart disease, pulmonary stenosis was associated with an interventricular septal defect in 85

cases, in 34 of these, the foramen ovale was also patent. In another 25 cases, pulmonary stenosis was not associated with an interventricular septal defect, and in 16 of these the foramen ovale was patent. These findings indicate that at least 2 in 7 with pulmonary stenosis will not have a ventricular septal defect, a fact which has not been generally recognized by cardiologists.

Eleven cases of pulmonary stenosis with no associated ventricular septal defect are recorded here. In 5 of these, there was an associated patency of the foramen ovale of varying size. In 10 of the cases the pulmonary stenosis was of sufficient degree to result in moderate to marked hypertrophy of the right ventricle.

HENRY K. TAYLOR, M.D.

**The Recruit's Heart. Reduplication of the First Sound. Heart Strain and a New Method of Calibration.** J. Stephen Lewis. *Am Heart J* 30: 447-458, November 1945.

This paper sets out to prove that reduplication of heart sounds after exercise is always of the first sound, never of the second, and that it is due to asynchronism of ventricular contractions brought on by dilatation of the right ventricle. The reduplicated sound is heard at the apex, best in the supine position and immediately after exercise—the first few beats. In the study here recorded, the measurements of heart size before and after exercise were made by a planimeter on tracings from roentgenograms. An 8.75 per cent increase in the entire heart area was found after exercise, and a 14.3 per cent increase in that portion of the cardiac silhouette to the right of the mid-line. From these figures, the author concludes that the enlargement of the heart following exercise is due to a right-sided dilatation. The right heart musculature being thinner than the left, the right side is the first to bulge with an increase in intracardiac pressure. The reduplication of the first sound in disease, as mitral stenosis, is due to the same cause, namely, a dilatation of the right side of the heart.

The author also discusses shifting of the heart in various positions, audibility of murmurs, pulse rate and blood pressure in boxers before and after prize fights, and heart strain.

This article is one of a series entitled "Recruit's Heart." Actually many of the observations on reduplication were made in children. The phenomenon was present in 72 per cent of a group from six to twelve years old and occurred with decreasing frequency at more advanced ages. HENRY K. TAYLOR, M.D.

**Congenital Diaphragmatic Hernia.** Edward J. Donovan. *Ann Surg* 122: 509-581, October 1945.

The most common sites of congenital diaphragmatic hernia in order of frequency are the esophageal hiatus, the foramen of Bochdalek, the foramen of Morgagni and the dome of the diaphragm. The embryonic development of the diaphragm is rather complicated, the ventral portion arising in the cervical region and descending to meet the dorsal portion or pleuroperitoneal membrane. There may be arrest at any point in the descent from the third cervical segment to the level of the twelfth thoracic vertebra. Failure of fusion of the two segments produces the pleuroperitoneal hiatus known as the foramen of Bochdalek. Failure of fusion of the costal and sternal fibers produces the hiatus

known as the foramen of Morgagni. Defects in the dome are similarly explained.

Symptoms of congenital hernia of the diaphragm vary from slight dyspnea, distention, and cough, to severe dyspnea, vomiting, cyanosis, pain, and evidence of intestinal obstruction. The severity of the symptoms depends largely on the amount of bowel present in the chest, the amount of pressure on the lung, heart, and other viscera, and the presence or absence of intestinal obstruction.

Physical signs may be absent or obscure, and diagnosis may be incorrectly made unless x-ray examination of the chest is done. The presence of gas-filled loops of bowel above the diaphragm should suggest the correct diagnosis. Studies with contrast media will confirm the findings and aid in determining what part or parts of the bowel are involved.

Operative repair of the diaphragmatic defect is the only way in which permanent cure can be obtained. The choice of time of operation varies with different surgeons but the author believes that early operation is almost invariably indicated since the possibility of partial or complete intestinal obstruction is ever present and operation after obstruction occurs is much more hazardous. In addition, the longer the operation is delayed, the less the abdomen will develop, so that it may eventually be insufficient to contain the displaced viscera.

The author reports 9 cases of hernia through the foramen of Bochdalek, with 7 recoveries and 2 deaths. The first of the fatal cases was in a child five weeks old who had a large posterolateral defect in the diaphragm with practically all of the small intestine in the chest and a definite high intestinal obstruction in the jejunum. Death occurred from shock twelve hours after operation. In the second fatal case the correct diagnosis had been made at the age of ten months. Permission for operation was consistently refused by the parents, however, until the child was nine years of age. At that time, the herniated viscera were brought down into the abdomen, which, however, was of insufficient size to accommodate them, so that they had to be returned to the thorax.

Eight additional cases are recorded. 3 of large posterior diaphragmatic defects, all successfully treated, 1 of esophageal hiatus hernia [actually a case of short esophagus], 2 of bilateral hernia through the foramen of Morgagni, with one postoperative death from pneumonia, 1 of eventration of the diaphragm, diagnosed roentgenologically as hernia, 1 of absence of the left hemidiaphragm with other congenital defects.

The author concludes that congenital diaphragmatic hernia is more common than the records in the literature would indicate, that children with obscure chest or abdominal complaints should have roentgen studies, with the possibility of diaphragmatic hernia in mind, that the diagnosis otherwise may easily be missed, and that early operation will produce permanent cure in a high percentage of cases.

BERNARD S. KALAYJIAN, M.D.

## THE DIGESTIVE SYSTEM

**Surgical Treatment of Congenital Atresia of the Esophagus, with a Report of Four Cases.** Conrad R. Lam. *J Pediatr* 27: 456-464, November 1945.

The outlook for a child with congenital atresia of the esophagus was formerly considered hopeless.

Within the past five years, however, advances have been made in the technic for surgical correction of this obstructive defect, and the literature now shows 28 of 70 patients living and well after operation. Thirteen of these patients had the preferred operation of direct anastomosis.

The author presents 4 cases of his own, with one fatality. The low mortality in this series is attributed in part to the fact that the 3 infants who survived were in excellent condition at the time of operation. Pneumonia from the aspiration of milk during persistent but futile attempts at feeding was prevented because of a relatively early diagnosis. It is stressed that if atresia of the esophagus is suspected, barium should not be used in the roentgen examination, since this contrast medium is very irritating to the bronchial mucosa. A small amount of iodized oil should be introduced through the catheter under fluoroscopic control and removed after the film has been made.

In connection with this abstract, see editorial in the September 1945 issue of *RADIOLOGY* (45: 204, 1945).

**Esophageal Lesions Associated with Acrosclerosis and Scleroderma.** Arthur M. Olsen, Paul A. O'Leary, and B. R. Kirklin. *Arch. Int. Med.* 76: 189-200, October 1945.

Scleroderma and acrosclerosis are alike in that sclerosing processes take place in the lower portion of the cutis. Acrosclerosis differs from scleroderma in that the trophic disorder in the former appears to have its origin in vasomotor disturbances. Acrosclerosis is a sclerodermic process which involves the distal parts of the extremities and the face and neck of patients who present the phenomena of Raynaud's disease. The authors believe that it constitutes a distinct clinical entity.

Approximately 350 cases of scleroderma or acrosclerosis were seen at the Mayo Clinic from 1930 to 1943, inclusive, in 36 of these dysphagia occurred or lesions of the esophagus were demonstrated. Roentgen studies were performed in 24 of this group and esophagoscopy in 8. The present study is concerned primarily with the 18 cases in which conclusive roentgenographic or endoscopic observations were made. These cases are presented briefly, roentgenograms are reproduced in 5. The symptoms of Raynaud's syndrome preceded or were coincident with the development of cutaneous manifestations in all 18 cases, and in every instance the diagnosis was acrosclerosis.

Conclusive roentgenographic features were demonstrated in 15 cases. Esophageal dilatation with atony of the esophageal musculature and diminution or absence of peristaltic movements occurred in 6 cases. Apparent spasm at the cardia, with obstruction, was noticed in 4 of these cases, and the passage of the barium meal was slower than normal. No studies were made in the dorsal decubitus position in this group. The roentgen diagnosis was cardiospasm.

In 9 instances, a diagnosis of esophageal hiatal hernia was made. In these cases, part of the stomach was found to be above the level of the diaphragmatic hiatus. The herniated portion of the stomach was distinguished readily from the phrenic ampulla of the esophagus. The patients were studied fluoroscopically in both the upright and dorsal decubitus positions. The passage of barium through the esophagus was slower than normal in each instance. In 2 patients,

there was obvious dilatation of the esophagus, giving the appearance of associated cardiospasm. In 8 of the 9 cases, the hernia was definitely of the short esophagus type and there was an associated stricture of the lower part of the esophagus and esophagogastric junction.

Esophagoscopic examination was performed in 8 cases. In 5 of these, a previous diagnosis of esophageal hiatal hernia had been made roentgenologically and this was confirmed in each instance. Strictures were found in 2 cases in association with hernias of the short esophagus type. The obstruction in both cases appeared to be the result of inflammation. In 2 other patients, ulceration was observed at the esophagogastric junction.

The authors conclude from this study that esophageal disturbances occur almost exclusively in cases of acrosclerosis rather than in generalized or diffuse scleroderma. They point out that the cutaneous lesions of acrosclerosis are confined to the hands, forearms, neck, and upper part of the thorax, while diffuse scleroderma may involve the entire skin of the trunk, arms, and hands. The facial lesions of acrosclerosis are likely to involve the oral cavity and to spread to the esophagus. When esophageal lesions are encountered in diffuse scleroderma, it is usually in those rare cases in which the scleroderma is cephalic in origin. Hence, esophageal lesions are likely to occur in those cases with early involvement of the face. The constant association of Raynaud's phenomena with acrosclerosis suggests that a disturbance of the autonomic nervous system may be involved in the pathogenesis of acrosclerosis. Explanations are offered for the occurrence of cardiospasm and hiatal hernia in association with acrosclerosis.

There is a complete review of the literature on the occurrence of dysphagia in scleroderma and acrosclerosis, with a summary of the data on the cases previously reported.

**Roentgen Examination in Congenital Intestinal Obstructive Defects in Infants. Its Aid in Planning Suitable Surgical Approach and Procedures for Their Correction.** Angus K. Wilson. *Am. J. Roentgenol.* 54: 498-502, November 1945.

Imperforate anus and atresia of the intestine are relatively infrequent, but intelligent correction is of utmost importance. The arrest in embryological development is usually at the level of the peritoneal reflection. In females it is usually about 2 cm and in males usually about 3 cm from the perineum. Atresia may be complete (imperforation) or fistulous, and an omalious opening may be present anywhere between the rectum and the urogenital tract. In 1930 Wangensteen and Rice (*Ann. Surg.* 92: 77, 1930) and Abt (*Am. J. Roentgenol.* 15: 710, 1930) showed that if the baby were suspended head down, intestinal gas would rise to its highest point and that a roentgenogram made with an opaque object in the anal dimple would demonstrate the extent of separation between the blind end of the rectum and the perineum.

Two cases are described by the author. These demonstrate the importance of waiting a sufficient length of time after inverting the infant before taking roentgenograms. Ten minutes is probably not too long. They also illustrate the superiority of lateral roentgenograms over those made in the anteroposterior projection, although both should be used. If there is an anal pouch, opaque medium should be injected into

it. This will permit an accurate estimate of the depth of tissue between the anal membrane or perineal surface and the blind end of the rectal pouch. Injection of opaque medium may also show a patent anal canal where obstruction has been suspected. Proper roentgen examination can be of great aid in guiding the surgical approach. CLARENCE E. WEAVER, M D

**Chronic Nonspecific Regional Enteritis.** Samuel Brown. *Am J Roentgenol* 54: 487-495, November 1945

Regional enteritis is not always limited to the terminal ileum, as was suggested by the earlier designation, "regional" or "terminal ileitis," but may involve any part of the small intestine or even the large bowel. Healthy segments of intestine may be found between affected areas. Reports by various observers reveal a tendency to constant increase in the frequency of the disease, especially since 1933. Only a few sporadic cases had been reported prior to 1932, and hardly any before World War I.

Though the terminal ileum is most often involved, no part of the small or large bowel is exempt. The pathological process is characterized by a subacute or chronic necrotizing ulceration on a granulomatous basis. The intestinal wall is stiffened and the lumen is narrowed, resulting at times in a stenosis with dilatation of the proximal portion of the bowel. Perforation may take place, with resulting fistula or abscess formation. A mass is often palpable in the right lower quadrant of the abdomen. The cause of the disease is still unknown. There is no adequate evidence to support a tuberculous etiology. None of the author's cases showed any evidence of tuberculosis of the lungs.

The diagnosis is established by small bowel roentgen study and by the barium enema. The roentgen signs are deformity of the contour of the bowel wall, narrowing of the lumen of the bowel, loss of mucosal pattern, hour-glass constrictions, rigidity and immobility of the intestinal segment, displacement of adjoining segments, demonstration of fistulous tracts, hypermotility, and stenosis with dilatation of the proximal portion of the bowel. Conditions to be differentiated from chronic non specific regional enteritis are chronic appendicitis, tuberculous ileitis, colitis, and small bowel tumors.

The author reports 12 cases. Some of the patients showed involvement of the jejunum and duodenum as well as of the ileum. The cecum was often found to be involved. Recurrences are frequent. The treatment in all cases was surgical. In three recurrent cases roentgen therapy was tried with good results.

CLARENCE E. WEAVER, M D

**Regional Enteritis.** H L Pugh. *Ann Surg* 122: 845-861, November 1945

The author reviews the salient features of regional enteritis and reports a series of 17 original cases. The roentgen demonstration of intestinal fistulae is significant but Kantor's "string sign" is generally accepted as the most important roentgen feature, being practically pathognomonic of regional enteritis involving the terminal ileum.

The disease most frequently confused with regional enteritis is acute appendicitis. In that condition, however, the onset is more abrupt and the point of maximum tenderness is likely to be more sharply defined. An abdominal mass is more common in re-

gional enteritis, the white blood count tends to reach a higher level, and the blood sedimentation rate to drop more decidedly. Regional enteritis may also be confused with intestinal tuberculosis, but in the latter there is usually an associated pulmonary tuberculosis. A barium enema study may aid in the differentiation of diverticulitis, amebiasis, and chronic ulcerative colitis.

In 9 of the 17 cases reported by the author there was evidence of extension of the process from the ileum to the large bowel. In 6 of these the cecum was involved, in 2 the sigmoid colon, and in one the transverse colon.

Intestinal fistulae were present in 6 of the cases. In 2 the communication was between the ileum and sigmoid, in one both the jejunum and mid-ileum communicated with the cecum. In one there was a fistulous communication between the ileum, sigmoid, and urinary bladder. There was a fistula between the terminal ileum and cecum in another, and between the ileum and transverse colon in the sixth. In 4 additional cases fistulae developed between the ileum or cecum and external abdominal wall.

In 3 cases small bowel obstruction constituted the paramount disability. Skipped areas were demonstrated in 3 patients, while fistula in ano was present in one. In one, hemorrhage from the bowel had been a notable but not a prominent symptom.

There was a recurrence necessitating a second operation in one case, while 3 cases cleared up without definitive surgery. There was one death in the series, on the fourth postoperative day, the result of uremia incident to urinary suppression, possibly due to sulfa drugs. ELLWOOD W. GODFREY, M D

**The Management of Postoperative Cholecholethiasis. Another Use for Solution G.** Benjamin Goldman, James Jackman, and Richard H Eastman. *Surg., Gynec. & Obst.* 81: 521-524, November 1945

This paper is concerned with recurrent common duct stones, their demonstration by cholangiography and their successful treatment in two cases by Solution G, a citrate solution containing magnesium, which has been previously used for the dissolution of urinary calculi (see Suby and Albright. *New England J Med* 228: 81, 1943. *Abst in Radiology* 41: 206, 1943).

Cholangiography is the only means of determining conclusively whether or not stones are present in the common bile duct following operation. Delayed or postoperative cholangiography is preferred by the authors to immediate or operative cholangiography. They use a 30 per cent solution of diodrast, first testing the patient for sensitivity. An injection of 10 c c is made under fluoroscopic control, and spot roentgenograms are obtained in the anteroposterior and oblique projections. A second injection of 10 c c follows, and a film is made using a Bucky diaphragm. A final oblique film is obtained after a third injection. If there is delay in duodenal filling, amyl nitrite or nitroglycerin may be used to differentiate spasm from organic obstruction.

The various methods of attack on postoperative common duct concretions are discussed and histories are given of the two cases in which the introduction of Solution G through the T-tube was followed by disappearance of the stones. Subsequent *in vitro* experiments were disappointing in that Solution G mixed with bile over a wide concentration range showed no apparent ability to dissolve biliary calculi of cholesterol type. The authors advance the theory that Solution G

so closely resembles *liquor magnesi citratis* (U S P) that the results may perhaps be explained on the basis of its cathartic action  
R E BOOTH, M D

**Fibrocystic Disease of the Pancreas.** David G Pugh *Am J M Sc* 210 681-687, November 1945

This paper, appearing under the heading "Progress of Medical Science," summarizes the present knowledge of fibrocystic disease of the pancreas "It may be stated," the author concludes, "that fibrocystic disease of the pancreas is a disease entity characterized by the celiac syndrome and chronic respiratory infection. There is pancreatic insufficiency and the most important procedure is examination of the duodenal contents for evidence of pancreatic achylia. Symptoms of respiratory infection often predominate and roentgenologic examination of the thorax may reveal pulmonary changes that are rather characteristic of this disease. Meconium ileus may be diagnosed, at times, by the roentgenologic examination of the abdomen."

A bibliography is appended

## THE MUSCULOSKELETAL SYSTEM

**Osteoid Osteoma** J F Hamilton *Surg, Gynec & Obst* 81 465-474, November 1945

Osteoid osteoma is a benign bone lesion of unknown etiology, occurring most commonly in men in the second and third decades. Pain is the predominant complaint and is frequently localized directly over the lesion. Pain or tenderness may antedate other clinical or roentgenographic evidence by several weeks or months. Exquisite "finger point" tenderness over a small area, rarely more than a centimeter in diameter, is an almost constant finding in superficial lesions. Swelling of the adjacent soft tissue is occasionally present. There may be a deposit of sclerotic new bone beneath the periosteum which obscures the real lesion unless overexposed roentgenograms are taken at different angles to bring out the nidus.

Osteoid osteoma has been found in the bones of the skull, spine, and extremities. A typical roentgenogram reveals a small oval or round area with smaller areas of rarefaction and condensation in the center. Surrounding this is a narrow zone of condensation, and outside this is a zone of rarefaction. The adjacent parent bone is sclerosed for a variable depth. Osteoid osteoma may occur in the cortex or in spongy bone and is benign. The microscopic appearance is quite typical, showing a vascular, richly cellular, embryonal type of osteogenetic connective tissue representing all elements necessary in the development of membranous bone. As the periphery is approached, there is more of the osteoid and calcified osteoid tissue. Beyond this the primitive vascular mesenchymal type of connective tissue predominates.

Osteoid osteoma must be differentiated from sclerosing non-suppurative osteomyelitis, Brodie's abscess, osteogenic sarcoma, and Ewing's tumor. With complete excision, the prognosis is uniformly good.

Five cases are presented in detail, the fourth being one in which an extensive sclerosis and thickening of the cortex of the involved bone had obscured the nidus of the osteoid osteoma. Photomicrographs of sections from 3 of the cases are reproduced in color, and other illustrations are included.

CHARLES R. PERRYMAN M D

**Roentgenographic Interpretation of Acute Hematogenous Osteomyelitis Treated with Penicillin.** W A. Altmeier and H G Reineke *Am J Roentgenol* 54 437-448, November 1945

During a period of twenty seven months the results of treatment with penicillin in 52 cases of acute hematogenous osteomyelitis were observed. Some of the earlier cases received less than 800,000 units, but experience has shown that a total dose of 1,500,000 or more units administered over a period of three or more weeks is desirable. The drug was usually given intravenously or intramuscularly, in amounts of 15,000 to 25,000 units at intervals of three hours. In some instances, it was administered by continuous intravenous drip. All but one patient recovered, and that one was admitted in moribund condition. The clinical results obtained fell into four groups.

**Group I** If the correct diagnosis was made early, within the first two or three days, and adequate treatment was started immediately, the results were truly excellent. The bony changes as seen on the roentgenograms were minimal, consisting of areas of localized periosteal reaction, small areas of patchy decalcification of the underlying cortex, little or no evidence of sequestration, and ultimate reconstruction of the bone. These findings were hard to see in some instances.

**Group II** When the diagnosis and treatment with penicillin were moderately delayed, the general and local infections were less promptly brought under control. After a week or more had elapsed, the roentgenogram showed periosteal reaction and localized patchy demineralization of the underlying bone. These increased progressively, becoming most marked one to five months after the onset of the infection. Recalcification of the demineralized areas followed, with the re-establishment of a normal or nearly normal appearance of the bone. Sequestration occasionally occurred.

**Group III** When the diagnosis and treatment were delayed for seven to ten or more days, or when the infection was unusually severe, the roentgenograms showed extensive bone destruction at the start of penicillin treatment, which increased on subsequent examinations. Sequestration occurred in some instances. Smaller sequestra were absorbed spontaneously and larger ones apparently acted as autogenous grafts.

**Group IV** In certain fulminating infections, surgical intervention after adequate preoperative preparation is still necessary as an emergency measure. In such instances, the bone destruction was extensive, due to the severity of the infection.

Periosteal reaction, patchy areas of demineralization and rarefaction of the involved bone and breaks in the adjacent cortex noted after ten or fourteen days in the course of penicillin therapy were first regarded as representative of "an extension of the osteomyelitic process." These are now interpreted as a measure of spontaneous absorption of the bone destroyed early in the course of the infection. The process suggests that adequate penicillin therapy given early arrests and controls the infection, converting an area of septic necrosis of bone to one of aseptic necrosis. The spontaneous absorption of the dead bone is followed by recalcification of the involved area, often with reestablishment of normal or nearly normal bony architecture. Reconstitution of the bone was accomplished with less resultant bone sclerosis than that seen with other, previous forms of treatment.

CLARENCE F. WEAVER M D



**Gaucher's Disease The Early Radiological Diagnosis.** William Tennent *Brit J Radiol* 18 356-358, November 1945

Gaucher's disease is a recessive familial disease of lipid metabolism. It first becomes apparent in childhood and runs a chronic course. Lipoid metabolism being incomplete, the cells of the reticulo-endothelial system take up lipoids from the blood stream, becoming progressively distended. There are two types of the disease, a visceral and an osseous, depending on where the chief lipid deposits occur. In the visceral form there is enlargement of the spleen, liver, and lymph nodes, with only slight changes in the bones. In the osseous form, the spleen, liver, and lymph nodes are not so greatly enlarged, there are extensive deposits in the bones, and anemia is more profound.

Bone changes may appear anywhere in the skeleton but are most prominent in the femora and spine. The lower ends of the femora show general osteoporosis, expansion, particularly on the mesial aspect, cortical thinning, and small medullary areas of erosion of the trabeculae. In the other bones, osteoporosis and expansion of the distal ends may appear. Osteoporosis of the spine may produce a kyphosis.

A case is reported. SYDNEY J. HAWLEY, M.D.

**Hypertrophic Osteoarthropathy Case Report.** Edward M. Kline *Am J Roentgenol* 54 519-523, November 1945

In 1889 von Bamberger (*Wien klin Wchnschr* 2 226 1889) reported 2 cases of bronchiectasis with skeletal involvement. Pierre Marie (*Rev de méd* 10 1, 1890) reported the same condition one year later, calling it hypertrophic pulmonary osteoarthropathy. The bone changes may, however, be secondary to other than pulmonary lesions. The pathogenesis of this condition is best explained either by the "toxic theory" or the "defective circulation theory." Von Bamberger was unable to produce the condition experimentally by injecting bronchiectatic secretions into the rectum of young rabbits. Mendlowitz and Leslie (*Am Heart J* 24 141, 1942) simulated congenital heart disease in dogs by anastomosing the left pulmonary artery to the left auricle. In one of two animals which showed increased cardiac output following this procedure, a definite subperiosteal proliferation developed.

The author reports a case in a boy, aged fourteen, who had tuberculosis of one knee, Pott's disease of the dorsal spine and later, pulmonary tuberculosis with a large cavity in one apex. There was extreme emaciation with genital underdevelopment and clubbing of the fingers and toes. The long bones were nearly all involved showing periosteal proliferation and lamination and demineralization. The distal epiphyseal region was more affected than the proximal. The patient died about sixteen months after he was originally observed.

CLARENCE E. WEAVER, M.D.

**Rheumatoid Spondylitis A Study of One Hundred Cases, with Special Reference to Diagnostic Criteria.** Edward W. Boland and Arthur J. Present *J A M A* 129 843-849 Nov 24 1945

Summarizing present day conceptions of the chronic progressive disease of the spine which is known by such terms as rhizomelic spondylitis, Marie-Strümpell's disease, etc., the authors conclude that the evidence favors the concept that the disease is actually a variant

of rheumatoid arthritis. The name "rheumatoid spondylitis" is therefore used to describe the syndrome.

No definite precipitating factor could be demonstrated in the 100 cases studied. Onset was usually insidious. Almost invariably the first complaints were limited to the lower part of the back, with episodes of aching and stiffness, transient back pain, or sciatica. Various other complaints were likewise encountered.

Roentgenographic features are quite characteristic. The earliest changes are usually in the sacroiliac region and consist in a blurring or "ground glass" appearance about the joints. The margins are no longer distinct or they may appear broken. The juxta-articular portion of the ilium and frequently the sacrum may demonstrate increased density, spotty osteoporosis, or both. More advanced changes are readily recognized. Changes in the apophyseal joints are not as definite or as constant as those in the sacroiliac articulations. Even with special technics, detailed studies often yield disappointing results. When changes are found early, they consist in haziness and indistinct outlining of the joint space. Later changes up to bony ankylosis are seen. Calcification and ossification of the paravertebral ligaments do not develop until the disease is moderately advanced.

The clinical course is variable, usually gradual, but going on relentlessly to the stage of "poker-back" deformity. The importance of suspecting the disease in cases of back pain is emphasized. It is pointed out that the possibility of rheumatoid spondylitis cannot be eliminated on the basis of negative roentgenograms alone unless persistent symptoms have existed for at least three years.

N. R. SHIPPY, M.D.  
(University of Michigan)

**Pneumoroentgenography with Oxygen in the Diagnosis of Internal Derangements of the Knee Joint.** H. H. W. Brooke, W. C. MacKenzie, and J. R. Smith *Am J Roentgenol* 54 462-469, November 1945

The anatomy of the knee joint, the capsule, the menisci, and the synovial membrane is reviewed. The technique of injection of oxygen into the joint cavity is described. After the injection of oxygen a tight elastic bandage is applied to compress the suprapatellar recess and thus force as much gas as possible down into the joint space proper. The exact position of the joint is located under the fluoroscope and is marked with a skin pencil. The knee joint is placed in an anteroposterior position over a curved cassette holder which allows about 30° flexion of the joint. Films are made in anteroposterior, 45° external rotation, 45° internal rotation, and true lateral positions. All exposures are on extra-speed or non-screen film in cardboard holders. The central ray is projected through the previously marked joint space which requires a 10° to 15° tilt of the tube cephalad.

The following points are of diagnostic value in the interpretation of pneumoroentgenograms of the knee joint:

1. Roughening and narrowing of cartilage surfaces, either articular surface coverings or the semilunar cartilages.
2. Uninterrupted gas columns along the inner aspect of the collateral ligaments of the joint where capsular structure should be firmly attached to the periphery of the menisci.
3. Increase in the soft tissue (increased density) in

the intercondylar or non-articular region of the joint with a corresponding lack of density in the lateral or medial region

4 Separation of the meniscus shadow from the contiguous bone structures

5 Loose or semi loose bodies calcified or otherwise

6 Joint space narrowing

7 Exostosis and eburnation of the articular surfaces The last three findings can be shown on routine roentgenograms of the knee Cruciate ligament injury has not so far been demonstrated

This procedure should not be used routinely but only in those cases which present a difficult diagnostic problem In these cases it has proved to be a useful adjunct in diagnosis  
CLARENCE E WEAVER, M D

**Genu Varum in Children Typical Roentgen Picture**  
Axel Renander Acta paediat 33 98-103, Oct 31, 1945 (In English)

A case of genu varum of unknown etiology, in a two and a-half-year-old boy, is presented Roentgen examination of the knees revealed the general calcium content to be normal The epiphyseal line in the proximal tibial epiphysis was sharply outlined but somewhat wavy The temporary calcific zone was of normal thickness in the epiphysis, on the metaphysis side it was somewhat thickened, especially medially At this point the metaphysis showed a bracket-like projection The bone structure in the projection was partly sclerotic and partly irregular, due to areas of rarefaction in the sclerotic tissues The epiphysis was perhaps slightly lower than normal medially, but its bone structure was normal Films of the femur suggested changes of the same kind The epiphyseal line was somewhat broader than normal medially, and there were medial thickening and sclerosis of the zone of temporary calcification on the metaphyseal side and projection of the metaphysis in a point

**Significance of Recurrent Osgood-Schlatter Strain**  
O T Steen Canad M A J 53 468-471, November 1945

A series of 14 cases of Osgood-Schlatter disease, or strain, as the author prefers to call it, is presented in an attempt to correlate the radiographic and clinical aspects It is shown how the tibial tubercle develops as a tongue projecting downward from the epiphysis of the tibial head This occurs between the ages of five and ten years In the course of its development the tubercle may assume numerous variations in size and shape, occasionally it may develop from multiple centers

Good roentgen technic is essential for accuracy in the diagnosis of this condition It is recommended that every examination of the knee include a lateral film of the tibial tubercle area and also a film of the opposite side for comparison The age of the patient is of paramount significance, since a non-fused epiphysis at the age of twenty one may be the first sign of abnormality

The outstanding radiologic feature, seen in all cases, is the presence of tubercle epiphyseal fragments or centers unfused after the age of twenty-one The unfused fragments may appear irregular in contour, heavily sclerosed (giving an amorphous appearance), or relatively osteoporotic Other radiologic signs, which may be present in various combinations, are a large major fragment with straight edges and sharp corners, elevated from the tubercle bed, fibrous bands,

made visible by dense scarring and often containing calcium deposits, joining the loose bodies to each other and to the tubercle bed, irregular amorphous calcium about the tubercle bed from a calcifying hematoma, osteomatous projections of the tubercle bed presumably due to traction on accumulated soft osteoid tissue incident to attempted repair

Analysis of the reported cases indicates that the onset of symptoms is often between the ages of fourteen and seventeen years, when athletic activity at school is most strenuous The unfused tubercle is most susceptible to injury at this age Trauma may be direct or indirect, the latter due to a violent pull of the quadriceps muscle on its ligamentous insertions Following the initial injury, failure to immobilize the damaged part adequately results in an unequal battle between the natural reparative tendency and the continuing damage done by the repeated minimal trauma of physiological locomotor activity The stress tolerance of the injured tissues is lowered and accumulating damage and persistent irritation result The inflammatory and proliferative response to repeated minimal trauma has led pathologists to call the condition osteochondritis, though there is nothing about the lesion to suggest infection

Illustrations are included to demonstrate the radiographic aspects  
PHILIP W DORSEY, M D

**Anhum (Dactylolysis spontanea) Report of Two Cases from Illinois**  
Arkell M Vaughn, John W Howser, and George Shropshire Ann Surg 122 868-877, November 1945

Two cases of anhum are reported from Illinois While these are the fiftieth and fifty-first cases, respectively, recorded in the United States since 1881, no 'true' case has been reported in a white patient Both the authors' patients were adult colored males who first noted a constricting band about the base of the fifth toe approximately two years before observation

The symptoms of anhum are purely local The characteristic roentgenographic findings are narrowing of the shaft, thinning of the cortex of the phalanx, pathologic fracture, and rotation of the distal phalanx The etiology is poorly understood The differential diagnosis must take into consideration leprosy syringomyelia, Raynaud's disease, neurotrophic ulcer, fissure due to injury, sclerodactylia scleroderma, and congenital constriction from an amniotic band The treatment of choice is a metatarsophalangeal disarticulation, with removal of the metatarsal head The general health is in no way affected

A tabular analysis of 10 cases recorded in the United States in 1938-45 is included to supplement the table of earlier American cases published by Spinzig (Am J Roentgenol 42 246 1939)

ELLWOOD W GODFREY, M D

**Review of Fractures and Dislocations of the Carpus**  
Hewson I J Kellam and Paul F McGoey Canad M A J 53 332-335, October 1945

The authors cite their experiences with 192 injuries of the carpus They found that among 331 successive fractures of the radius and ulna, 7 per cent had associated fractures or dislocations of the wrist bones Approximately 83 per cent of the carpal injuries were of the scaphoid Usually scaphoid fractures were demonstrable on the first x-ray examination occasionally re-

peat studies were necessary for confirmation of a clinical diagnosis, and in a few instances the fracture was visible only on an oblique film. The treatment for scaphoid fractures consisted of immediate immobilization in a plaster-of-Paris bandage, with the wrist in slight dorsiflexion and radial deviation. The average period required for union was thirteen and a half weeks. The greater the interval between injury and immobilization, the longer was the period before union was established. Unreduced displacement of fragments was also a factor in late union. Operative interference was limited to cases with avascular necrosis and ununited fractures with pain and local arthritic change. Arthritis was not usually demonstrable roentgenologically before three months.

Fractures of the triquetrum, next in frequency to scaphoid injuries, were treated with a "Colles type of plaster" and an average of five weeks was required for union.

The lunate bone was most frequently dislocated. An unusual dislocation of the hamate and capitate, with interposition of the triquetrum, is illustrated.

RUSSELL WIGH, M D

**March Fractures** Walter Scott Surg Gynec & Obst 81 525-529, November 1945

The author reports a study of 58 cases of march fracture. Metabolic studies were made in 48 of these, leading to the conclusion that a mild hypothyroid state may be a predisposing factor.

## GYNECOLOGY AND OBSTETRICS

**Value of Salpingography in Surgical Diagnosis** Phineas Bernstein Am J Surg 70 164-175, November 1945

Because of the intimate association of the fallopian tubes with the ovaries and other adnexal structures, it is to be expected that any significant tumor or other pelvic mass involving these organs will produce some demonstrable change in the contour of the tube—providing, of course, it remains patent and the dye is able to outline the lumen. Large ovarian tumors will lengthen the tube and pull it up out of the pelvis as they expand, and often the lengthened tube may be seen almost coiled about the suspected mass. A normal appearing dye shadow of the uterine cavity and both tubes would appear to indicate that a suspected mass has no affiliation with these structures and may arise primarily from the upper abdomen.

From 4 to 6 cc of Viscorayopake is injected into the cervical canal in the conventional manner and films are made while maintaining slight pressure on the plunger of the syringe. Fluoroscopic observations may be made. After the examination, variable quantities of the dye may be suctioned back, often all is recovered if the uterotubal junction is blocked. Viscorayopake seems to overcome the objections to lipiodol in that it may be absorbed into the blood stream with no ill effect, in fact, it is rapidly excreted by the kidneys, thereby outlining the renal collecting system and ureters.

The procedure is contraindicated during active uterine bleeding, during the interval phase of ovulation, and during the six-month postpartum period or for thirty days following surgical procedures about the pelvis. Acute pelvic infections, acute endocervicitis, gonorrhea, intrauterine or ectopic pregnancy, and cervical carcinoma are also contraindications.

Four cases are reported, with surgical confirmation, in which the procedure indicated the correct diagnosis when results of the bimanual examination were doubtful.

ALFRED O MILLER, M D

**The Diagnosis of Cephalopelvic Disproportion.** W T McConnell Kentucky M J 43 303-307, November 1945

The following simple method for roentgen pelvimetry has been devised by the author and used for over twenty years with satisfactory results, although no comparative statistics are given.

In a cephalic presentation, anteroposterior and lateral views are taken of the mother's pelvis. The longest diameter of the fetal skull is measured in centimeters on the anteroposterior film and this amount is subtracted from the value of the longest transverse diameter of the inlet. Similarly, on the lateral projection the value of the longest diameter of the fetal skull is subtracted from that of the anteroposterior diameter of the inlet, measured in the usual manner from the first sacral segment to the inner surface of the symphysis. The differences obtained from the two sets of measurements are added and then divided by 2. The following table is used to interpret the factor obtained after this division.

Plus 1.5	No disproportion
Plus 1.0	Possible disproportion
Plus 0.5	Probable disproportion
Plus 0.0	Definite disproportion
Minus 0.5	Almost absolute disproportion
Minus 1.0	Absolute disproportion

The plus 1.0 through minus 0.5 cases are borderline. In this group, the ability of the head to mold, the character of the pains, the ease with which the cervix dilates, the degree of ossification of the skull, the angle of the inlet, the shape of the sacrum, other pelvic abnormalities, and the status of the soft tissues in the birth canal will determine the method of delivery. The test of labor can be used before cesarean section is elected. Where the measurement factor is minus 1.0, or beyond, section is always performed without the test of labor.

In a breech presentation, anteroposterior and postero-anterior projections of the abdomen are made. The long diameter of the fetal head is obtained by averaging the longest diameters on both films. The longest transverse diameter of the inlet is likewise averaged from the two films. The average figure obtained from the fetal head is then subtracted from the inlet diameter. The resultant factor is interpreted according to the above table.

No roentgen aids are used in measuring the pelvic outlet, digital examination being relied upon for this information.

LESTER M J FREEDMAN, M D

**The Isometric Method of X-Ray Pelvimetry as a Routine Procedure** Charles M McLane Am J Obst & Gynec 50 495-500 November 1945

For four years the author has used the isometric technique of x-ray pelvimetry described by Steele and Javert (Am J Obst & Gynec 43 600, 1942; Abst in Radiology 40 108, 1943). As a result, he believes it is of great value and that the method "gives as much information about the pelvis and cephalopelvic relationships as any procedure yet described."

The method is simple and requires only two films,

from which the measurements are made. A distorted centimeter scale is prepared and retained for all subsequent examinations. This scale consists of a series of pictures of a centimeter ruler taken at various distances from the x-ray table top. The height of the ruler from the top of the table is noted beside each distorted picture. A photograph of such a scale is shown in the article.

Anteroposterior and lateral films are made with the patient in the same position, i. e., recumbent with three pillows under the back to lessen the distorted view of the inlet. A notched metal centimeter rule is placed vertically before the symphysis when the lateral exposure is made.

The usual routine measurements are then made, corrections being determined from the distorted centimeter scale. The author clearly demonstrates the system of lines employed in making the measurements.

STANLEY H. MACINT, M D

### **Congenital Absence of the Sacrum and Coccyx Complicating Pregnancy** William Berman. *Am J Obst & Gynec* 50: 447-450, October 1945

A rare congenital abnormality of the pelvis is reported, in a 20-year-old primipara who was first seen when she was sixteen weeks pregnant. She gave a life-long history of urinary incontinence, but the remainder of the history was essentially negative.

The patient was of short stature, with a waddling gait. The vertebral column was straight and terminated at the junction of the last lumbar vertebra and the pelvic girdle. X-ray films made at term showed the pelvic inlet to be asymmetrical, not corresponding to any pure type of classification. It was cylindrical in shape, with the greatest diameter running antero-posteriorly. There was absence of the sacrum and coccyx. After an unsuccessful trial of labor, a low cesarean section was performed, with the delivery of a living infant. The child died shortly thereafter and autopsy revealed a congenital heart lesion and complete atelectasis of all lobes of the lung. Radiographs of the infant's spine showed no abnormalities.

A case of absence of the sacrum and coccyx, also with associated urinary incontinence, was reported by Price (*Arch Surg* 26: 1043, 1933).

STANLEY H. MACINT, M D

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**Arteriovenous Aneurysm of Great Cerebral Vein and Arteries of Circle of Willis** Formation by Junction of the Great Cerebral Vein and the Straight Sinus and by the Choroidal Arteries and Anomalous Branches of the Posterior Cerebral Arteries. Bernard J. Alpers and Francis M. Forster. *Arch Neurol & Psychiat* 54: 181-185, September 1945.

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has been the only common finding in the three cases but its exact cause is unknown.

R. S. MACINTYRE, M D  
(University of Michigan)

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In classifying the various types of thrombosis, the author has modified Hepler's classification (*J Urol* 31: 527, 1934). He recognizes four main groups: (1) primary (arising in small capillaries and small or large veins), (2) secondary (due to extension from neighboring veins or to emboli), (3) suppurative, (4) non suppurative.

The pathogenesis of renal thrombosis and thrombophlebitis is undetermined. The primary type, originating in the venous system of the kidney, may follow an acute pyelonephritis, ileocolitis (in children), trauma, or surgery. The secondary type may be due to an inflammatory or tumor embolus, retrograde thrombosis, or, rarely, compression by an extrarenal mass. The pathologic changes are dependent on the anatomical location of the thrombus and the presence or absence of infection. As a general rule, the involved portion of the kidney is a dark red or chocolate color. There may be subcapsular hemorrhages with wedge shaped destruction of the renal parenchyma which is determined by venous occlusion.

Symptoms are variable. Chief among them are localized pain in the kidney region, hematuria, albuminuria, oliguria or anuria, fever, leukocytosis, gastro-intestinal symptoms, collapse, and renal enlargement. Amyloid disease and lipid nephrosis are frequently associated with renal thrombosis. In most cases, the diagnosis of thrombosis is made at operation or at autopsy. In only 3 of the 228 cases was a correct clinical diagnosis made.

Röntgenograms may show renal enlargement. Retrograde films (intravenous pyelography is of little value) in early cases show irregular, incomplete filling of the renal pelvis. In a later stage, the renal pelvis may be blocked, but the dye can be forced into it, producing an irregular shrunken outline, such as may be seen in tumors. Irregularity and notching of the renal pelvis are due to a marked bullous edema and are often misinterpreted as renal papillomatosis. Thrombosis of the renal veins must be differentiated from acute pyelonephritis, renal tumor, perinephritic abscess, acute hemorrhagic nephritis, and thrombosis of the renal artery.

Prognosis is poor. In the absence of operation, the mortality rate in infants is 95 per cent. The operative mortality in a series of 23 cases was 34.5 per cent. The ideal treatment would seem to be removal of the thrombus from the renal vein but this has never been done except in the case of tumor thrombi. As a practical substitute, nephrectomy is performed. Preoperative and postoperative care is extremely important, and it is best to consult with the pediatrician and the clinician as to the best course to follow. Femoral vein ligation is recommended as a prophylactic measure against development of renal thrombi in cases of thrombophlebitis of deep veins of legs complicating pregnancy, diseases of the female pelvic organs, and urological and gynecological surgery.

MAURICE D. SACHS, M D

## SINUS TRACTS

**Roentgenologic Exploration of Sinus and Fistulous Tracts.** Benjamin Copleman. *Am J Surg* 70 197-200, November 1945

Seven cases are presented illustrating the roentgen study of sinus and fistulous tracts. Draining sinuses are too often treated by non-interference, when a detailed investigation might easily lead to the discovery of

a remediable lesion. None of the patients in the series reported suffered any ill effects from the examination. Every wound in which healing is not soon established should have the benefit of roentgen study.

The author does not discuss the technic in any detail, nor does he evaluate the different opaque media. Lipiodol was the only medium used in the presented cases. The advantages of sodium iodide solution are not considered.

CHARLES R. PERRYMAN, M D

## RADIOTHERAPY

### NEOPLASMS

**Results in the Treatment of Skin Cancer.** Leonard B. Goldman. *New York State J Med* 45 2186-2189, Oct 15, 1945

Almost 100 per cent 5-year cures were obtained at the Queens General Hospital, (Jamaica, N Y) in the treatment of 267 cases of skin carcinoma from 1936 to 1945. The therapeutic measures included radon, radium and roentgen irradiation, electrocoagulation, and surgical excision.

The importance of administering a cancericidal dose of radiation at the first attempt at treatment is stressed. The author prefers to give this dose at one sitting when possible, using the fractionation method only in large lesions. Irradiation is the method of choice for lesions of the face since least scarring results.

Glass radon bulbs 5 mm in size, or glass radon seeds 10 mm in length and varying in strength from 10 to 200 mc, are applied directly to precancerous lesions or small, superficial basal-cell carcinomas for a total dose of 300 to 600 millicurie minutes. The caustic beta rays are responsible for the lethal effect obtained. Gold radon seeds are used to good advantage in lesions 1 cm or less in diameter having an irregular surface. They may be applied directly or planted interstitially. In a flat lesion 1 cm square, 4 gold seeds of 1 mc each are placed about the growing edge for approximately 300 mc hr or 23 mc destroyed. A lethal effect is obtained by implantation of one 2-mc gold seed into a lesion 0.5 cm in diameter and of 3 seeds totaling 5 mc into a lesion 1.5 cm in diameter. Radium in lead or platinum tubes may be placed in position with adhesive tape for a total of 150 to 300 mg hr per square centimeter. If the lesion is over 0.5 cm in thickness, radium is used at a distance of 1 cm by means of a dental compound mold. With this application and using 1-mm platinum filtration, a minimum dose of 1,500 mg hr is delivered with an increase to 2,000 mg hr if the lesion shows marked infiltration or if there is adherence to bone or cartilage.

Roentgen therapy has an advantage over radium therapy where the lesion is located near sensitive areas such as the eyelids. Adequate screening can be obtained with lead foil 0.5 mm thick when low voltages are used, whereas impractical thicknesses of lead are needed for gamma ray protection. Chaoul contact therapy or 100-kv unfiltered radiation may be used on the small superficial lesions for a minimum of 4,000 r in one dose. The bulky forms of skin cancer are best treated with roentgen ray (120 to 140 kv 2 to 4 mm aluminum filtration), with a dose of at least 5,000 r, which may be fractionated.

In the absence of x ray or radium, electrocoagulation

may be elected to eradicate small lesions. Destruction must be wide to be effective. Electrocoagulation is also indicated in the treatment of recurrent lesions following irradiation.

Surgical excision is used primarily in treating carcinomas of the extremities, since these tumors are notoriously radioresistant. The incidence of regional node involvement is relatively high and in selected cases regional block dissection is advised. Irradiation of the drainage areas was found to be of dubious value. If it is to be effective, a sharp epidermitis must be obtained. The scalpel is also employed to remove a post-irradiation ulcer which fails to respond to conservative measures. Plastic repair should be delayed six months if doubt exists as to complete excision of the tumor.

LESTER M. J. FRIEDMAN, M D

**Some New Facts Concerning the Prognosis and Treatment of Carcinoma of Cervix by Radiation.** Malcolm Donaldson. *Proc Roy Soc Med* 39 10-17, November 1945

Donaldson deals first with the question of why carcinomas of the cervix considered of similar stage as to advancement should show such different responses to radiation. Thus, he points out, hinges for the most part on the histology of the tumor. He calls attention to the fact that "radiocurability" keeps pace quite well with the degree of differentiation of cell structure; the less differentiated growths are most apt to show recurrence after treatment. In the history of these tumors, the more differentiated have usually been of the slowest growth.

Prognosis should be based upon pre-irradiation biopsy. *Material should be taken from the growing edge of the tumor, that from the center may be too necrotic to be of value* [Italics are the abstractor's]. Sections are taken at least twice during treatment for comparison, to determine if the original idea as to prognosis has been correct. In view of his observations, the author has adopted the massive dose method, rather than fractionation, in the radium therapy of undifferentiated growths. Histologic studies suggest definite improvement following this change in technic, but clinical results are not yet available.

Drs. Neary, Green, and Blomfield discuss Donaldson's paper, taking up the matter of radium technic. They point out that extensions in the broad ligament are relatively unaffected by intra-uterine applicators. They estimate that around the cervix they deliver about 8,000 r and at the level of the pelvic wall about 4,000 r. The rectum receives about 4,000 r.

The authors and discussants are to be commended for their frankness and honesty of approach and their

from which the measurements are made. A distorted centimeter scale is prepared and retained for all subsequent examinations. This scale consists of a series of pictures of a centimeter ruler taken at various distances from the x-ray table top. The height of the ruler from the top of the table is noted beside each distorted picture. A photograph of such a scale is shown in the article.

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MAURICE D. SACHS, M.D.

generation may be seen, varying from hyperchromatic nuclei to a coalescence of epithelial cells with the formation of an intra-acinar cell mass or a pseudo-giant cell.

It is important to differentiate these conditions from malignant growths of the thyroid in order to save the patient from the postoperative complications which may follow radical resection of the gland and regional lymph nodes. Usually the malignant tumor is nodular, with an irregular surface, in contrast to the diffuse smooth enlargement in the conditions under discussion. There is also frequent invasion of adjacent tissues, with regional lymph node involvement. This condition may be quite difficult to distinguish from a late hard struma fibrosa. However, the diffuseness of the latter process, even if confined to one lobe, and its excessive hardness, serve to differentiate it from a malignant tumor.

Treatment should be aimed at relief of symptoms. A positive diagnosis is essential. Thus biopsy, irrespective of the form of therapy, should be carried out as a preliminary procedure if there is any question of the diagnosis at operation, or if treatment solely by x-ray is contemplated. Roentgen irradiation alone, following biopsy, has given excellent results in struma lymphomatosa. It may almost be used as a diagnostic test. The response is rapid and the gland will shrink markedly in size in two or three weeks. Deep x-ray of adequate voltage is sufficient, up to 1,200 to 1,500 r on each side of the neck in divided doses of 100 to 200 r. Time must be allowed to elapse between courses of radiation to allow for skin tolerance of the dose administered. In one of the author's cases there was permanent regression of the gland after 800 r to each side of the neck. In another there was an excellent initial response to the same dose, but recurrence after six weeks required additional treatment, which was followed by a favorable result. The effect of x-ray therapy on pseudo-giant-cell thyroiditis may be sufficient to warrant its use. However, it is hard to evaluate, as this earlier, more acute form of thyroiditis often subsides spontaneously and without operation. X-ray therapy is ineffective for the late stages of fibrosis described under struma fibrosa.

Eleven case histories are included. A long list of references is appended. ALFRED O. MILLER, M.D.

## RADIATION EFFECTS

**Small Bowel Stricture Following Radiation Therapy for Carcinoma of the Fundus Uteri.** Harry C. Saltzstein. *Surgery* 18: 550-560, November 1945.

Practically all the recorded cases of post-irradiation damage to the small intestine have followed treatment for cervical cancer. The author, however, found 3 case reports of bowel damage following treatment for corpus carcinoma and here adds a fourth. Although treatment was in part by radium, the damage apparently followed protracted courses of x-ray therapy, since at operation there was widespread involvement of the entire small bowel and other abdominal organs.

The patient was a 49-year-old woman with adenocarcinoma of the fundus and cardiac disease contraindicating operation. X-ray therapy was given to the abdomen with daily treatments for six weeks. Six months later radium was inserted in the uterus for one week. One month after this, another series of deep x-ray treatments was given, daily for five to six weeks. Diarrhea started shortly thereafter, followed by abdominal pain and cramping, weight loss, and anorexia.

Supportive treatment led to improvement in the general condition, but after several months cramp-like abdominal pain recurred. Following a sudden severe attack associated with vomiting, the patient was hospitalized and treated with small bowel intubation. X-ray examination showed moderate dilatation of the small bowel loops, many of them filled with gas. The barium passed slowly beyond the upper jejunum and at the end of six hours was still present in the upper small bowel. A 24-hour film showed barium distributed throughout the intestine. There was some irregularity of the small bowel pattern in the pelvis. Some of the barium had apparently passed into the large bowel and was seen in the region of the cecum. The x-ray diagnosis was incomplete small bowel obstruction, but it was uncertain whether this was due to x-ray damage or to metastatic deposits in the abdomen. Following two similar attacks at intervals of several weeks, it was decided that the obstruction was probably due to adhesion, and operation was undertaken.

As the abdomen was entered, the fat seemed fibrous and thickened, the fascial layer was not clearly defined, the muscle was a dark chocolate color. The small intestine was thin and pale and the blood vessels were not very prominent. The uterus was normal in size. The lateral folds were adherent. Posteriorly the sigmoid was adherent to the posterior surface of the uterus in the cul-de-sac, the adnexa were bound down low in the pelvis and were small and atrophic, the adhesions being quite dense. Further exploration of the deep pelvis revealed a matting down of the adnexa posterior to the uterus.

Exploration of the small bowel showed a thickening of the terminal ileum for about 12 inches. At one point, 10 inches from the cecum, there was a dense adhesion binding the small bowel to the anterior right peritoneum far out toward the cecum. The omentum in the region of the liver was densely adherent to the under surface of the liver and to the parietal peritoneum. The whole picture was one of post-x-ray therapy damage, with extensive changes in the small bowel, pelvic organs, omentum, and peritoneum. The patient made a good recovery. J. E. WHITELEATHER, M.D.

**Possible Effectiveness of the L. Casei Factor ("Folic Acid") Concentrates on Refractory Anemia and Leukopenia, with Particular Reference to Leukopenia Following Radiation Therapy.** C. J. Watson, W. H. Sebrell, J. L. McKelvey, and F. S. Daft. *Am. J. M. Sc.* 210: 463-470, October 1945.

The effectiveness of the L. casei factor ("folic acid") and its concentrates in the treatment of leukopenia in rats receiving a deficient diet plus sulfonamides has been fully established. It was decided to use the material in patients suffering from refractory or aplastic anemia, as well as in those in whom leukopenia alone, of various causes, was exhibited. An arbitrary dose of 5 mg. per day for six days was decided upon. Half of the material was given in the forenoon and half in the late afternoon, usually in milk or tomato juice.

In so far as the refractory anemias were concerned, it was scarcely hoped that the L. casei factor concentrates would achieve the beneficial effects observed experimentally, since there was no reason to believe that a dietary factor was operative in the human cases.

The only changes which might be construed as related to the administration of folic acid were in the group of

willingness to dwell upon radiation failures in carcinoma of the cervix, an attitude too seldom encountered

PERCY J DELANO, M D

**Treatment of Carcinoma of the Cervix by Interstitial Radium Needles at the Rhode Island Hospital Supplemental Report** George W Waterman and Ralph Di-Leone *Am J Obst & Gynec.* 50 482-488, November 1945

The purpose of this paper is to report the ten-year survival rates in 309 cases of cervical carcinoma seen between 1926 and 1933, and to add a new series of 198 cases seen between 1934 and 1938. The total of 607 cases is then reviewed. The cases were seen in the Gynecological Tumor Clinic of the Rhode Island Hospital, where treatment is by interstitial radiation with long platinum needles of low intensity (see Pitts and Waterman *Surg, Gynec & Obst* 64 30, 1937 *Abst in Radiology* 28 516, 1937), with the addition of deep roentgen therapy in 1936 and thereafter.

The cases are classified into four clinical stages. The percentages for each stage are quoted for the old as well as for the new series. These totaled 3.9 per cent, 30.8 per cent, 41 per cent, and 24.3 per cent for stages 1, 2, 3, and 4, respectively. It was noted that the incidence of Stage 3 cases had increased while that of Stage 4 cases had appreciably decreased, indicating some effect of cancer education on the community, but the percentages of earlier cases showed little change.

Of the 309 patients treated between 1926 and 1933, 100 (35.7 per cent) survived five years and 69 (24.5 per cent) survived ten years. Of the second group of 198 cases, 21 were too advanced to be treated. Of those treated, 36.7 per cent survived five years. During the years 1936 to 1938 the results were improved by the addition of deep x-ray therapy. Among 127 cases treated in that period there were 44.9 per cent five-year survivals as compared to the previous 36.7 per cent survival rate. In the total group of 507 cases there was a 36 per cent survival rate at the end of five years [The percentages given here are "relative," obtained by deducting those cases too advanced for treatment, those in which treatment was refused, and those receiving primary treatment elsewhere. Absolute percentages are also included in the original paper.]

Complications due to treatment included fistulas, trophic ulcerations and hemorrhage, ureteral stricture, and other urinary tract lesions. There were altogether 21 such injuries, or 11.8 per cent, in 177 cases treated in 1934-38. In 24 cases, intestinal lesions (including fistulas) developed.

The effect of age on five-year survivals was noted and, contrary to the usual belief, it was found that a definitely better prognosis existed for the younger age group in this series.

The authors emphasize the need for carefully working out the distribution and spacing of the radium sources in order to compute tissue dosage for the individual patient.

STANLEY H MACHT M D

## NON-NEOPLASTIC DISEASE

**Hyperophthalmopathic Graves' Disease** J H Means *Ann Int Med* 23 779-789, November 1945

The author introduces the term "hyperophthalmopathic Graves' disease" to designate those cases of endo-

crine imbalance in which "the ophthalmic phenomena overshadow the thyrotoxic, in which, indeed, thyrotoxicosis may actually be absent." Attention is called to the paper here because of the brief mention of irradiation in the discussion of therapy. Irradiation of the pituitary, in order to reduce its thyrotropic activity, was tried in one case. Rapid and impressive improvement followed, but whether or not this was due to the treatment is not certain. Roentgen ray treatment to the retrobulbar portion of the orbits was also tried in a number of cases, with questionable benefit in a few. The rationale of this therapy is that the muscles are the seat of lymphocytic infiltration, which might be dispelled by roentgen-rays with consequent diminution in bulk, and perhaps improvement in muscle tone.

**Struma Lymphomatosa, Struma Fibrosa and Thyroiditis** J A Schilling *Surg, Gynec. & Obst* 81 533-550, November 1945

There is generally some confusion in the various groups of non-specific chronic thyroiditis, *i.e.*, struma lymphomatosa (Hashimoto), struma fibrosa (Riedel), and the pseudo-giant-cell type, or struma granulomatosa (De Quervain). It is the author's opinion that struma lymphomatosa is a definite clinico-pathological entity of unknown etiology while struma fibrosa and its pseudo-giant-cell variant are different manifestations of the response of the thyroid to inflammation.

Struma lymphomatosa occurs between the ages of 40 and 60 and is limited almost exclusively to females. The predominant complaint is usually a goiter with vague pressure symptoms which has been present for a number of years. There is usually a history of recent acceleration of symptoms. The gland is diffusely enlarged and firm to moderately hard to palpation. It may be fixed to the trachea on swallowing and is seldom tender. The basal metabolic rate in the author's cases was -5 to -25 per cent. Microscopically there is a uniform degeneration of the acini with a diffuse infiltration of lymphocytes throughout the gland, in all cellular planes and between the acini. There are numerous areas of lymph follicles with their characteristic germinal centers composed of larger lymphocytes and reticulum cells with their mitotic figures.

Struma fibrosa and its giant-cell variant occur between the ages of 20 and 40, and predominantly, though not exclusively, in females (60 to 80 per cent). The symptoms are largely due to pressure, in the giant-cell variant there may be stabbing shooting pains in the shoulder, neck, and ear. The duration of symptoms varies from one to two years in the case of struma fibrosa and from one to twelve months in the case of the giant cell variant. In 30 per cent of the cases the involvement is unilateral. The consistency is one of extreme hardness and a malignant growth is often suggested. There are usually dense, firm adhesions to the surrounding soft tissues in struma fibrosa, while in the giant cell variant this is usually not the case. Microscopically struma fibrosa presents a striking picture of hard, dense, hyalinized, straight, fibrous tissue, and little else at a casual glance. Epithelial elements, if they remain, are compressed, usually there is complete absence of acinar epithelium. In the giant-cell variety there is a marked increase in fibrous tissue that is hard, coarse, and often hyalinized, though to a lesser degree than in struma fibrosa. There is an acute degenerative process in the acinar epithelium and often many stages of this de-



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## Angiographic Diagnosis of Expanding Intracranial Lesions by Vascular Displacement<sup>1</sup>

CARL F LIST, M D, and FRED J HODGES, M D

Ann Arbor, Mich.

THROUGH THEIR combined efforts, neurosurgeons and roentgenologists have accomplished much to place the diagnosis of expanding intracranial lesions upon an exact basis. Pneumoencephalography, and particularly ventriculography, have been highly successful in the analysis of obscure situations. The more recently developed procedure of intracranial angiography is another standard method of neurosurgical diagnosis. To a certain extent angiography and ventriculography are interchangeable, more importantly, they supplement each other, each having its advantages and limitations. In cases of brain tumor, angiography has the following advantages:

1 It is a safe procedure, even in the presence of high intracranial pressure, as it avoids traumatizing punctures of the diseased brain and does not materially interfere with intracranial hydrodynamics, the patients, therefore, face major surgical intervention in better condition following angiography than after ventriculography. This is especially true of comatose subjects in whom, as a rule, roentgenographic contrast methods are indispensable for an accurate diagnosis. In such cases ventriculography is notoriously dangerous and may jeopardize the patient's dwindling chances of survival, whereas angiography may provide as much or even more infor-

mation at a far lesser risk. A total of 194 angiographies, among which were 136 cases of expanding intracranial lesion, were performed in the University Hospital without a single death attributable to the procedure. Serious immediate complications, such as cerebral thrombosis or late radioactive damage due to the use of thorotrast, were not observed.

2 Angiography may give information both as to the location and the anatomic type of the suspected lesion. The site of the lesion is revealed by localized displacement of cerebral blood vessels. The angiographic picture is most striking if the tumor encroaches on large vessels, *i e*, if it is located not far from the surface of the brain. Conversely, tumors buried deeply in the cerebral substance or within the ventricular cavities are less clearly demonstrated. The anatomic type of the lesion can be frequently recognized by a characteristic manner of vascular deformation and by a specific pathologic vascular pattern within the lesion itself. Moreover, in cases with doubtful diagnosis, angiography not only rules out tumor (as does ventriculography), but may contribute positive evidence for a vascular lesion.

From the above considerations the following indications for angiography have been evolved:

<sup>1</sup> From the Department of Surgery, Section of Neurosurgery, and the Department of Roentgenology, University of Michigan Medical School, Ann Arbor, Mich. Accepted for publication in March 1946.

leukopenias following roentgen therapy Here there was a consistent increase in the leukocytes following the administration of folic acid concentrates This increase occurred in spite of continued radiation therapy Where radium was used, this observation was not considered valid, since radium alone will sometimes produce marked increases in the leukocyte count

Although the leukocyte increases have not been proved to be due to the administration of folic acid, the results justify further investigation

BENJAMIN COPLEMAN, M D

**Plastic Repair of Radiation Ulcers of the Sole.** Paul W Greeley U S Nav M Bull 45 827-830, November 1945

A simplified method of plastic repair of post irradiation ulcers developing under the metatarsal heads (following excessive doses of x rays or radium in the treatment of plantar warts) is described This operation, which includes disarticulation of the toe at the metatarsophalangeal joint, is limited to those lesions near the bases of the small toes, the great toe should never be sacrificed

## EXPERIMENTAL STUDIES

**Quantity and Quality of the Radiations Scattered within a Medium Irradiated by High Voltage Radiation** C W Wilson Brit J Radiol 18 344-355, November 1945

To interpret the dose of radiation in terms of energy absorbed, it is necessary to know the atomic characteristics of the absorbing media and the quantity and quality of scattered radiation as well as of the primary beam The determination of the quantity and quality of the scattered radiations is very complex and at present is at best an approximation Measurements of both quantity and quality were made under varying conditions and compared with calculated values

Quantitative measurements yielded curves of the same type as did the calculated values, but of different degree The theoretical and experimental curves agree fairly well for small field areas, but for larger areas the experimental values are considerably in excess This suggests that for small fields back-scatter arises chiefly from a single scattering process but that for large fields multiple scattering occurs

The difference between the calculated and measured values is much greater in water and paraffin wax than in sulfur, suggesting that in areas such as the knee, where there is a high percentage of denser material, the effective wave length of the total radiation may be shorter than in soft tissue

Measurements of quality reinforce the observations on quantity of the back-scattered radiation The effective wave length of scattered radiations is considerably greater than the calculated value for a single scatter The difference is so great that it is apparent that the wave lengths within a scattering medium are very different from the primary beam The scattered radiation was found to be softest at the surface of a water

medium, becoming harder with depth up to a constant value at relatively great depths The larger the field size the longer is the wave length of the scattered radiation  
SYDNEY J HAWLEY, M D

**Biological Evaluation of 20 Million Volt Roentgen Rays I Acute Roentgen Death in Mice** Henry Quastler and Robert K Clark Am J Roentgenol. 54 723-727, December 1945

Secondary electrons from high energy roentgen rays are much more penetrating than those from conventional roentgen rays Because of this, the depth dose from rays generated at high voltages increases to a maximum below the surface and from there on slowly decreases Thus for 20-million-volt roentgen rays at a target distance of 45 cm, the maximum depth dose occurs at a level of about 3 cm and amounts to about three times the surface dose At 10 cm it is about 225 per cent of the surface dose The effects of high-energy radiation may also vary in other respects from conventional radiation In order to determine what, if any, these effects may be, biological experiments must be utilized The present paper deals with the comparative effects, on mice, of roentgen rays generated at 20 million volts and at 200,000 volts A phantom was devised so that the entire body of the animal would receive an approximately homogeneous dose It was found that the animals react similarly to both qualities of radiation They lose weight, show anorexia and diarrhea, become progressively cachectic and die, if the dose has been large enough Quantitative evaluation of effectiveness showed that 1 r of the higher energy radiation was equivalent to about 0.78 r of 200-kv rays Further investigations are in order to establish the significance of this conversion factor  
L W PAUL M D

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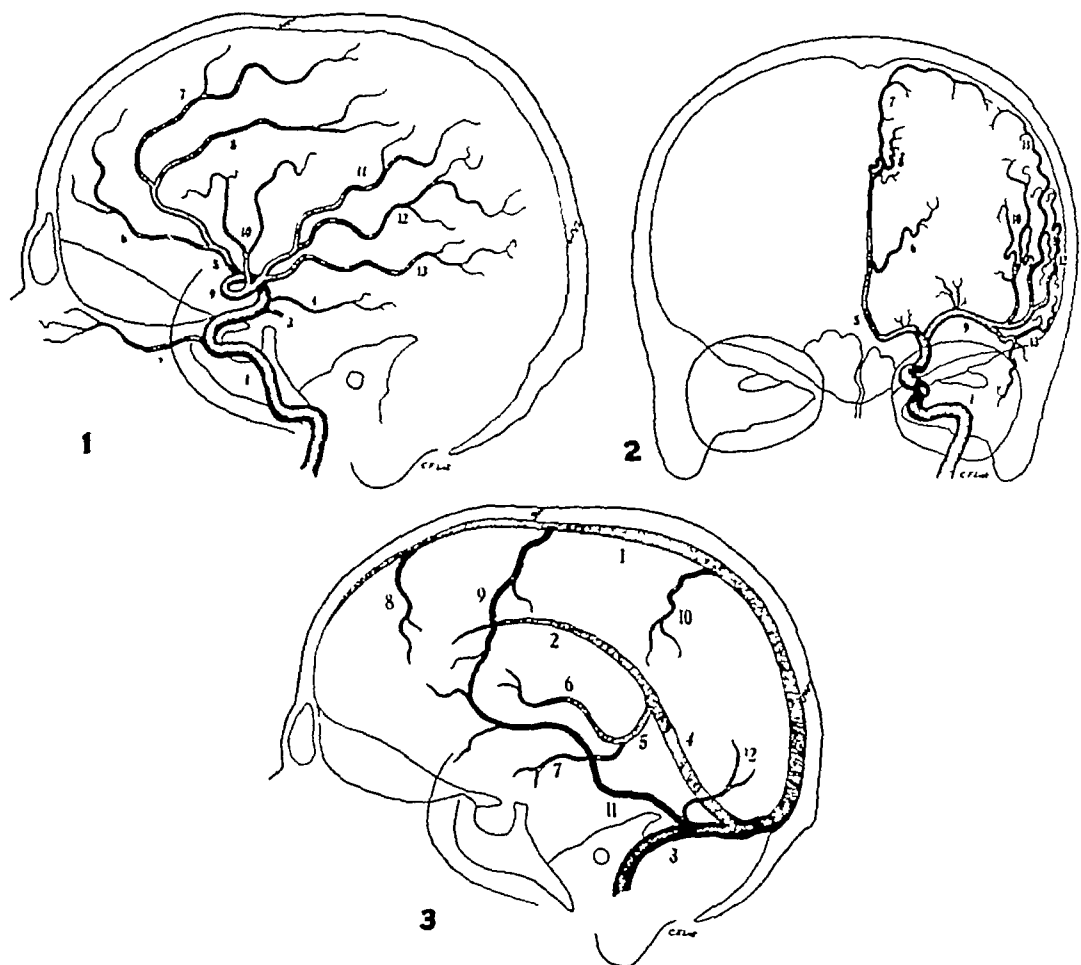
1 It is a safe procedure, even in the presence of high intracranial pressure, as it avoids traumatizing punctures of the diseased brain and does not materially interfere with intracranial hydrodynamics, the patients, therefore, face major surgical intervention in better condition following angiography than after ventriculography. This is especially true of comatose subjects in whom, as a rule, roentgenographic contrast methods are indispensable for an accurate diagnosis. In such cases ventriculography is notoriously dangerous and may jeopardize the patient's dwindling chances of survival, whereas angiography may provide as much or even more infor-

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Figs 1-3 Schematic drawings of normal arteriograms and venogram obtained by injection of the internal carotid artery

Figs 1 and 2 Arteriograms in lateral and anteroposterior projections

1 Internal carotid artery 2 Ophthalmic artery 3 Posterior communicating artery 4 Anterior choroidal artery 5 Anterior cerebral artery 6 Frontopolar artery 7 Callosomarginal artery 8 Pericallosal artery 9 Middle cerebral artery 10 Ascending frontoparietal artery 11 Posterior parietal artery 12 Angular artery 13 Posterior temporal artery

Fig 3 Venogram in lateral projection

1 Superior sagittal sinus 2 Inferior sagittal sinus 3 Transverse sinus 4 Straight sinus 5 Great cerebral vein of Galen 6 Internal cerebral vein 7 Basal vein of Rosenthal 8 Frontal ascending vein 9 Rolandic vein of Trolard 10 Parietal ascending vein 11 Communicating temporal vein of Labbé 12 Descending temporo-occipital vein

1 In certain expanding lesions of the base of the brain and skull

2 In space-occupying lesions of the cerebral hemisphere which have been grossly localized, or at least lateralized, by other diagnostic methods

3 In the differential diagnosis of neoplasm *versus* vascular lesion (especially aneurysm or vascular malformation)

On the other hand, angiography is

definitely inferior to ventriculography

1 In cases of increased intracranial pressure without any localization

2 In tumors of the ventricular system, basilar ganglia, midbrain, and posterior fossa

For the angiographic technic, the reader is referred to an earlier paper (1). It may be briefly mentioned here that satisfactory diagnostic information is secured from a

stereoscopic set of arteriograms and venograms in lateral projection and a single arteriogram in anteroposterior projection (total of 5 films) Diagrammatic drawings of normal carotid arteriograms in lateral and anteroposterior projections and of a venogram in lateral projection are presented here to facilitate the understanding of the pathologic pictures to follow (Figs 1, 2, and 3)

This study deals with the characteristic displacement of cerebral vessels caused by space-occupying lesions In a subsequent publication the specific vascular pattern within intracranial neoplasms will be discussed The present report is based on angiographic examination of 136 patients with expanding intracranial lesions<sup>2</sup> treated at the University of Michigan Hospital from 1941 to 1946 The material will be grouped in the following manner

- 1 General angiographic aspects of expanding intracranial lesions
- 2 Tumors of the basilar surface of the brain
- 3 Tumors of the temporal lobe
- 4 Tumors of the occipital lobe
- 5 Tumors of the frontal lobe
- 6 Tumors of the parietal lobe
- 7 Tumors of the basal ganglia and thalamus

#### 1 GENERAL ANGIOGRAPHIC ASPECTS OF EXPANDING INTRACRANIAL LESIONS

Expanding intracranial lesions produce either localized or generalized enlargement of the brain volume by (a) their own bulk or the presence of cysts and hemorrhages, (b) accompanying brain swelling, (c) enlargement of the ventricles These changes result in typical deformities of intracranial blood vessels Normally the arteries of the brain take a remarkably tortuous course, frequently forming complete loops Any localized space-occupying process tends to displace the vessels away from the lesion Thus the arteries become separated from one another, thinned, and stretched, and they follow a straightened

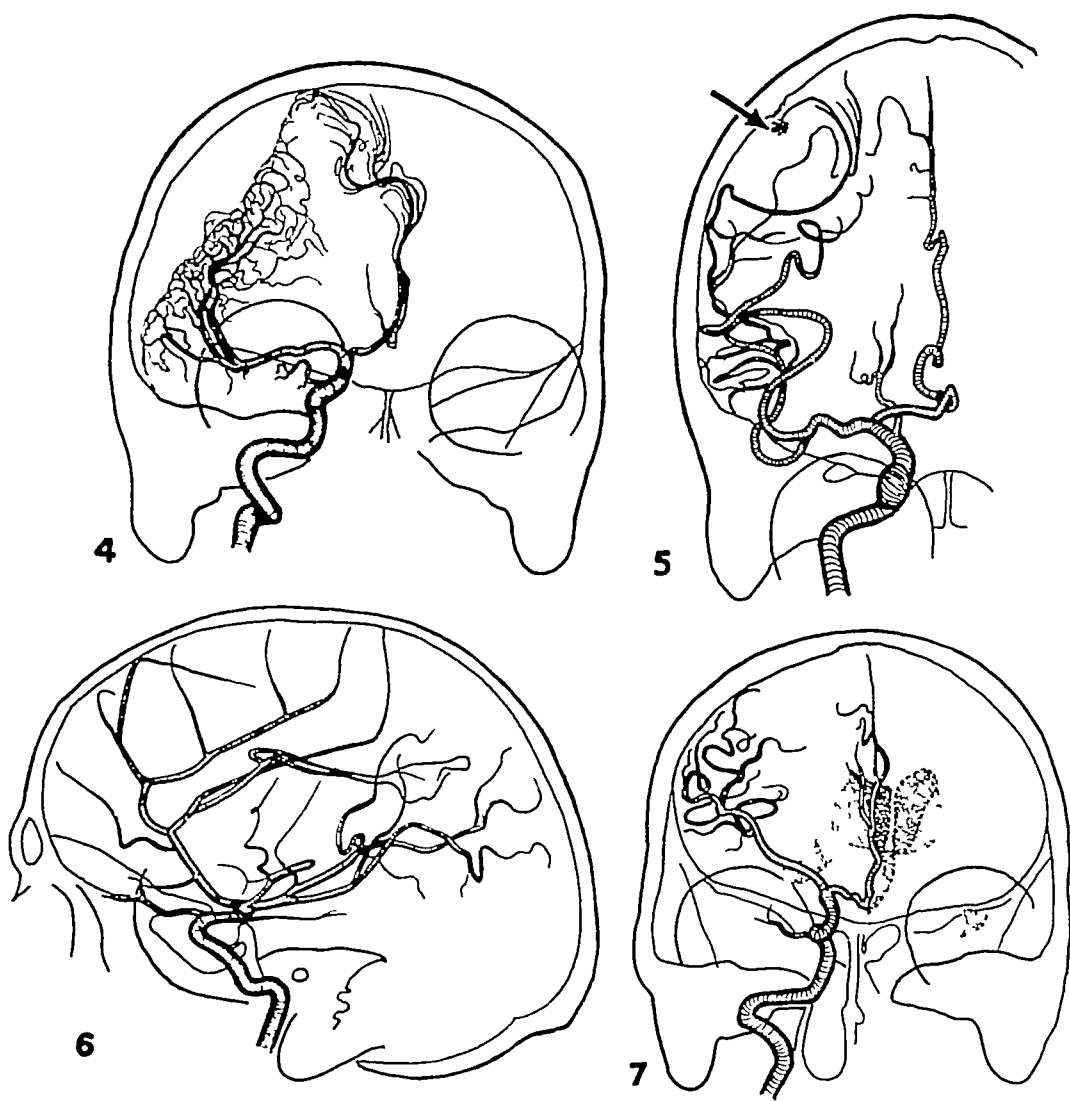
course The cerebral veins, too, are displaced, but usually engorged In cases of brain tumor, visualization of cerebral veins frequently is better than in cases with normal intracranial pressure, because of venous stasis and general slowing of cerebral blood circulation Since the cerebral veins have a variable arrangement, their deformation and displacement are of only limited diagnostic value

The type of vascular displacement depends upon three variable factors, *viz*, the location, size, and pathologic type of the lesion In epicerebral expanding lesions, such as epidural or subdural hematoma, the cortical vessels are displaced and separated from the convexity of the skull by an interposed area devoid of vessels This is characteristically demonstrated only on the anteroposterior film, which gives an "optic cross section" of the lesion (Fig 4)<sup>3</sup> In circumscribed superficial tumors (*e g*, meningioma), an area of spread and displaced vessels is surrounded by a corona of crowded (but otherwise normal) blood vessels Here again the anteroposterior view may more graphically portray the extent of the lesion in depth than the lateral projection (Figs 5 and 38) If a tumor is diffusely infiltrating, deeply located, and accompanied by considerable swelling of the surrounding brain, the vessels, especially the arteries, are spread and stretched over a wide area (Fig 6)

Any sizable enlargement of a cerebral hemisphere causes shifting of the midline structures such as the anterior cerebral artery Normally, this vessel keeps in the midline or transgresses it over short stretches only if it happens to possess great physiologic tortuousness The changed position of the anterior cerebral artery often is not quite so sensitive an indicator of an expanding hemispherical process as is the midline shift of the ventricular system (Fig 7) Obvious displacement of the anterior cerebral artery *per se* does not reveal a specific localiza-

<sup>2</sup> Among them 122 true neoplasms

<sup>3</sup> Since satisfactory reproduction of original roentgenograms proved difficult, one of us (CFL) made line drawings by careful tracing of the films



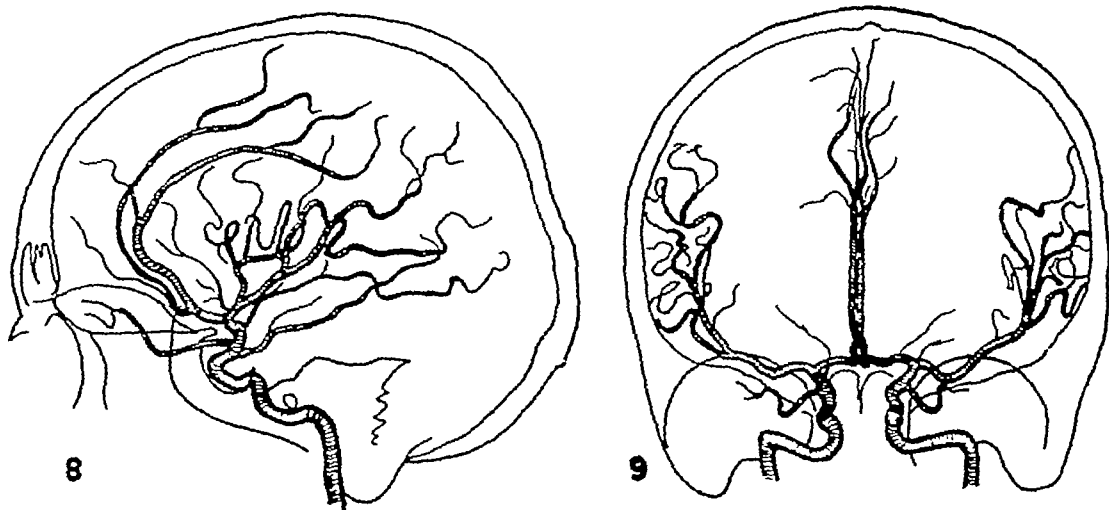
Figs 4-7

- Fig 4 Anteroposterior arteriogram of subdural hematoma  
 Fig 5 Anteroposterior arteriogram of parietal meningioma    Arrow points to special circulation at attachment of tumor  
 Fig 6 Lateral arteriogram of diffuse astrocytoma of frontal and parietal lobes  
 Fig 7 Simultaneous arteriogram and ventriculogram in anteroposterior projection, meningioma of the middle fossa

tion of the space-occupying lesion. Since the rigid falx resists the pressure of an enlarged hemisphere, the upper medial edge of the hemisphere is less displaced than the lower and anterior parts in the midline plane, which tend to shift underneath the falx. This is shown by a definite notching of the anterior cerebral artery around the lower edge of the falx (Figs 4 and 21).

Ventricular enlargement cannot be

recognized in angiograms with the same precision as in ventriculograms, in fact, it can be diagnosed only by indirect evidence. Internal hydrocephalus produces elevation and rounding out of the anterior half of the anterior cerebral artery *without* midline shift (Figs 8 and 9) (2, 3). This is explained by the elevation of the corpus callosum, the contour of which is marked by the pericallosal artery. In extreme hy-



Figs 8 and 9 Arteriograms of obstructive internal hydrocephalus, lateral projection and simultaneous bilateral arteriogram in anteroposterior projection

drocephalus, also, the arteries of the convexity appear to be stretched, with the sylvian vessels taking a straight diagonal course. Other less reliable signs for severe hydrocephalus are, according to Egas Moniz (4), elevation of the inferior sagittal sinus, elongation of the straight sinus, depression of the internal cerebral vein and of the great vein of Galen.

## 2 TUMORS OF THE BASILAR SURFACE OF THE BRAIN

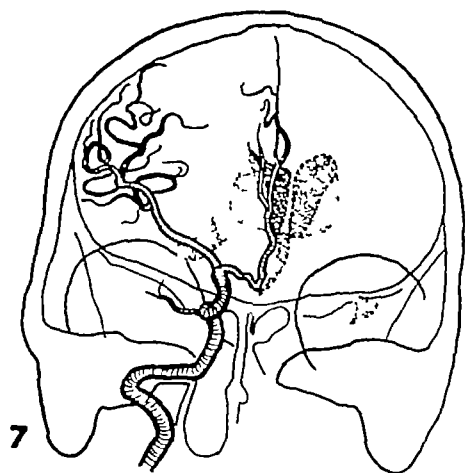
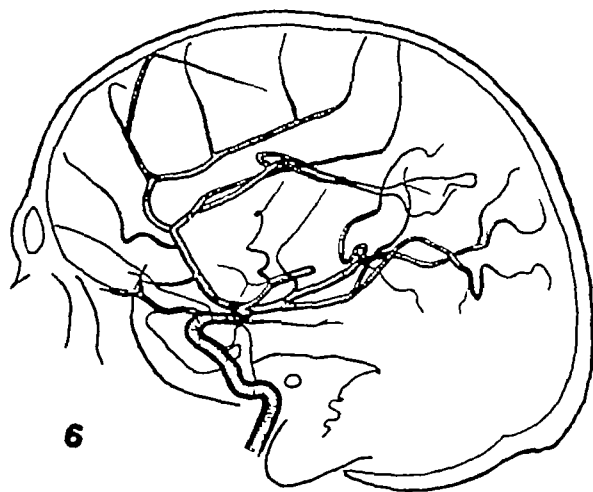
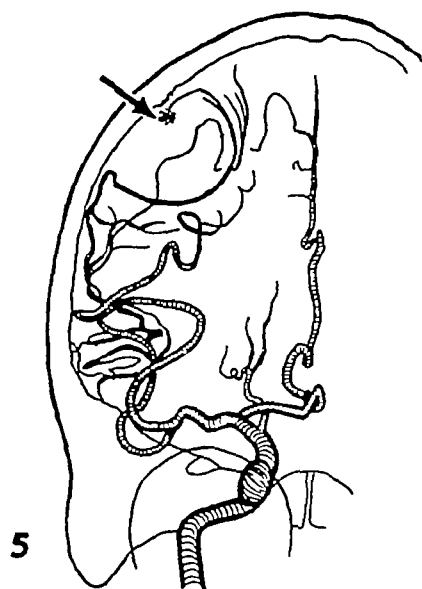
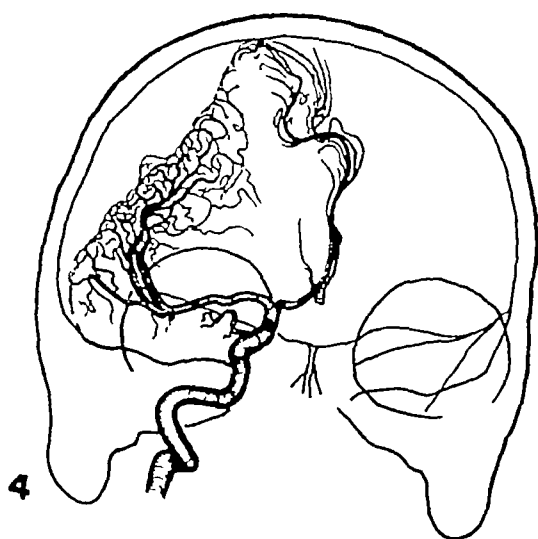
Even small tumors at the base of the brain can be diagnosed, as a rule, by clinical signs and simple roentgenography of the skull. The main reason for resorting to angiography in these cases is the necessity of differentiation from aneurysms originating from the carotid, basilar, or vertebral arteries or from the circle of Willis. Furthermore, the relationship of the tumor to the large arteries of the base can be well demonstrated by angiography, a significant aid in determining the operability of the lesion. Since many basal tumors attain only moderate size, they displace the adjacent larger arteries without changing the configuration of intracerebral vessels.

(a) *Extradural tumors* arising from the sphenoid bone (sarcoma), the sphenoidal sinus (carcinoma, mucocoele), or from the depth of the sella turcica (pituitary ade-

noma) elevate the extradural (subclmoid, parasellar, intracavernous) portion of the internal carotid artery and displace it laterally (Fig 10), they may compress the vessel considerably and thereby prevent a proper filling of intracerebral vessels (3).

(b) *Parasellar tumors*, often meningiomas, open up the first curve of the carotid siphon by flattening and depressing the extradural portion of the carotid artery and by vertical elevation (antero-medial displacement) of the supraclinoid segment of the carotid. Thus, the intradural supraclinoid portion of the carotid appears unusually erect and elongated (Figs 12 and 13). The angiographic aspect of large parasellar tumors which extend far to the floor of the middle fossa will be described below (see Tumors of the Temporal Lobe).

(c) *Suprasellar tumors* (meningioma, adenoma of the pituitary, craniopharyngioma) likewise elevate the supraclinoid portion of the carotid but, in contrast to parasellar tumors, tend to displace the vessel laterally and do not significantly widen the first curve of the carotid siphon. In addition, these lesions characteristically displace the first segment of the anterior cerebral artery upwards and slightly laterally. As a result, the beginning of the anterior cerebral artery forms a downward concave arch above the lesion (Figs 14 and 15). Far advanced pituitary adenomas



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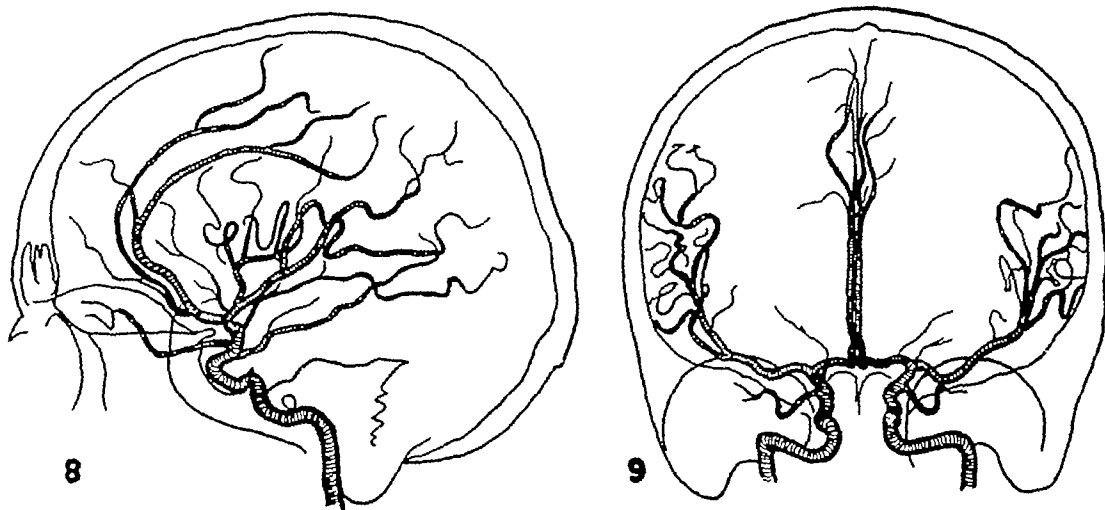
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tion of the space-occupying lesion. Since the rigid falx resists the pressure of an enlarged hemisphere, the upper medial edge of the hemisphere is less displaced than the lower and anterior parts in the midline plane, which tend to shift underneath the falx. This is shown by a definite notching of the anterior cerebral artery around the lower edge of the falx (Figs 4 and 21).

Ventricular enlargement cannot be

recognized in angiograms with the same precision as in ventriculograms, in fact, it can be diagnosed only by indirect evidence. Internal hydrocephalus produces elevation and rounding out of the anterior half of the anterior cerebral artery *without* midline shift (Figs 8 and 9) (2, 3). This is explained by the elevation of the corpus callosum, the contour of which is marked by the pericallosal artery. In extreme hy-





Figs 8 and 9 Arteriograms of obstructive internal hydrocephalus, lateral projection and simultaneous bilateral arteriogram in anteroposterior projection

drocephalus, also, the arteries of the convexity appear to be stretched, with the sylvian vessels taking a straight diagonal course. Other less reliable signs for severe hydrocephalus are, according to Egas Moniz (4), elevation of the inferior sagittal sinus, elongation of the straight sinus, depression of the internal cerebral vein and of the great vein of Galen.

## 2 TUMORS OF THE BASILAR SURFACE OF THE BRAIN

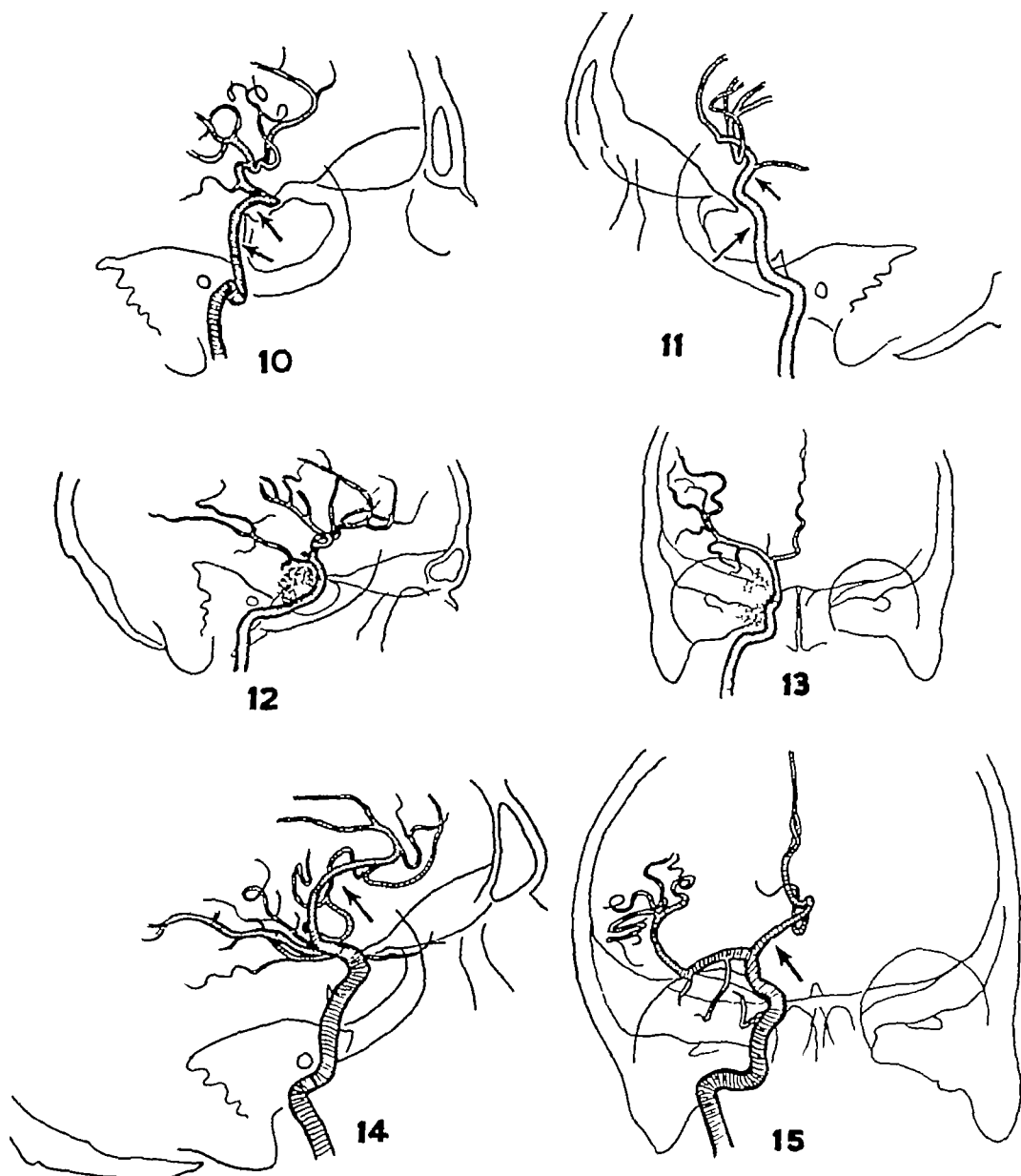
Even small tumors at the base of the brain can be diagnosed, as a rule, by clinical signs and simple roentgenography of the skull. The main reason for resorting to angiography in these cases is the necessity of differentiation from aneurysms originating from the carotid, basilar, or vertebral arteries or from the circle of Willis. Furthermore, the relationship of the tumor to the large arteries of the base can be well demonstrated by angiography, a significant aid in determining the operability of the lesion. Since many basal tumors attain only moderate size, they displace the adjacent larger arteries without changing the configuration of intracerebral vessels.

(a) *Extradural tumors* arising from the sphenoid bone (sarcoma), the sphenoidal sinus (carcinoma, mucocoele), or from the depth of the sella turcica (pituitary ade-

noma) elevate the extradural (subclnoid, parasellar, intracavernous) portion of the internal carotid artery and displace it laterally (Fig 10), they may compress the vessel considerably and thereby prevent a proper filling of intracerebral vessels (3).

(b) *Parasellar tumors*, often meningiomas, open up the first curve of the carotid siphon by flattening and depressing the extradural portion of the carotid artery and by vertical elevation (antero-medial displacement) of the supraclnoid segment of the carotid. Thus, the intradural supraclnoid portion of the carotid appears unusually erect and elongated (Figs 12 and 13). The angiographic aspect of large parasellar tumors which extend far to the floor of the middle fossa will be described below (see Tumors of the Temporal Lobe).

(c) *Suprasellar tumors* (meningioma, adenoma of the pituitary, craniopharyngioma) likewise elevate the supraclnoid portion of the carotid but, in contrast to parasellar tumors, tend to displace the vessel laterally and do not significantly widen the first curve of the carotid siphon. In addition, these lesions characteristically displace the first segment of the anterior cerebral artery upwards and slightly laterally. As a result, the beginning of the anterior cerebral artery forms a downward concave arch above the lesion (Figs 14 and 15). Far advanced pituitary adenomas



Figs 10-15 Basilar tumors

Fig 10 Lateral arteriogram of mucocoele of sphenoid sinus with extradural parasellar extension

Fig 11 Lateral arteriogram of pituitary tumor with extradural and intradural parasellar and suprasellar extension

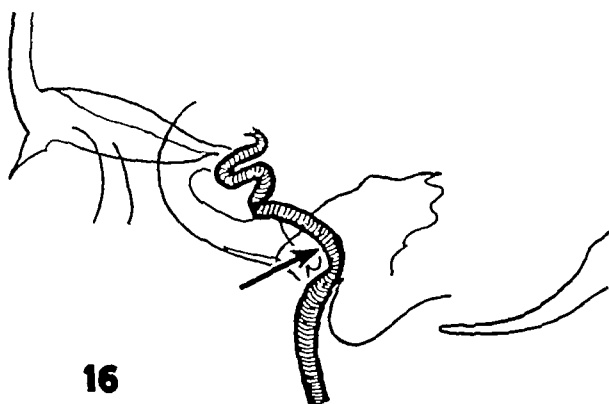
Figs 12 and 13 Arteriograms of parasellar tumor with special vascular pattern lateral and anteroposterior projections

Figs 14 and 15 Arteriograms of suprasellar tumor, lateral and anteroposterior projections

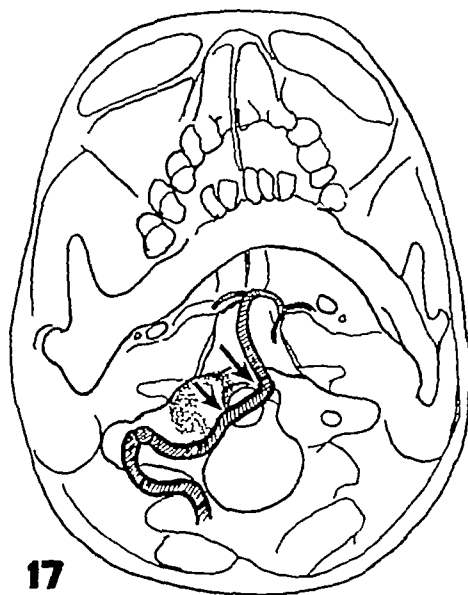
with extradural, parasellar, and suprasellar extension may show a combination of angiographic signs of the three groups described (Fig 11)

(d) Tumors of the petrous apex and of the

retrosellar region may grow both into the middle and posterior fossa. If the lesion is extradural, e.g., a chordoma, the carotid is compressed and elevated in its extradural retrosellar course (Fig 16). If the tumor is



16



17

Figs 16 and 17. Basilar tumors

Fig 16 Lateral arteriogram of chordoma of petrous apex with extradural retrosellar extension  
 Fig 17 Vertebral arteriogram in basilar projection Psammoma at anterior rim of foramen magnum

*intradural* (meningioma, epidermoid), the angiographic signs are those of a parasellar or basal temporal lobe lesion (see below)

(e) It has been stated above that in *tumors of the posterior fossa* ventriculography is the method of choice. In *extramedullary lesions of the 9th, 10th, 11th, and 12th nerves*, (syndromes of Avelis, Schmidt, Jackson, and Tapia), however, vertebral angiography has some value. First, this method may reveal an aneurysm of the vertebral artery, second, neoplasms in this position are difficult to demonstrate by ventriculography. Vertebral arteriograms should be made both in lateral and basilar projections, since the latter view best brings out the displacement of the vertebral and basilar arteries (Fig 17)

### 3 TUMORS OF THE TEMPORAL LOBE (2)

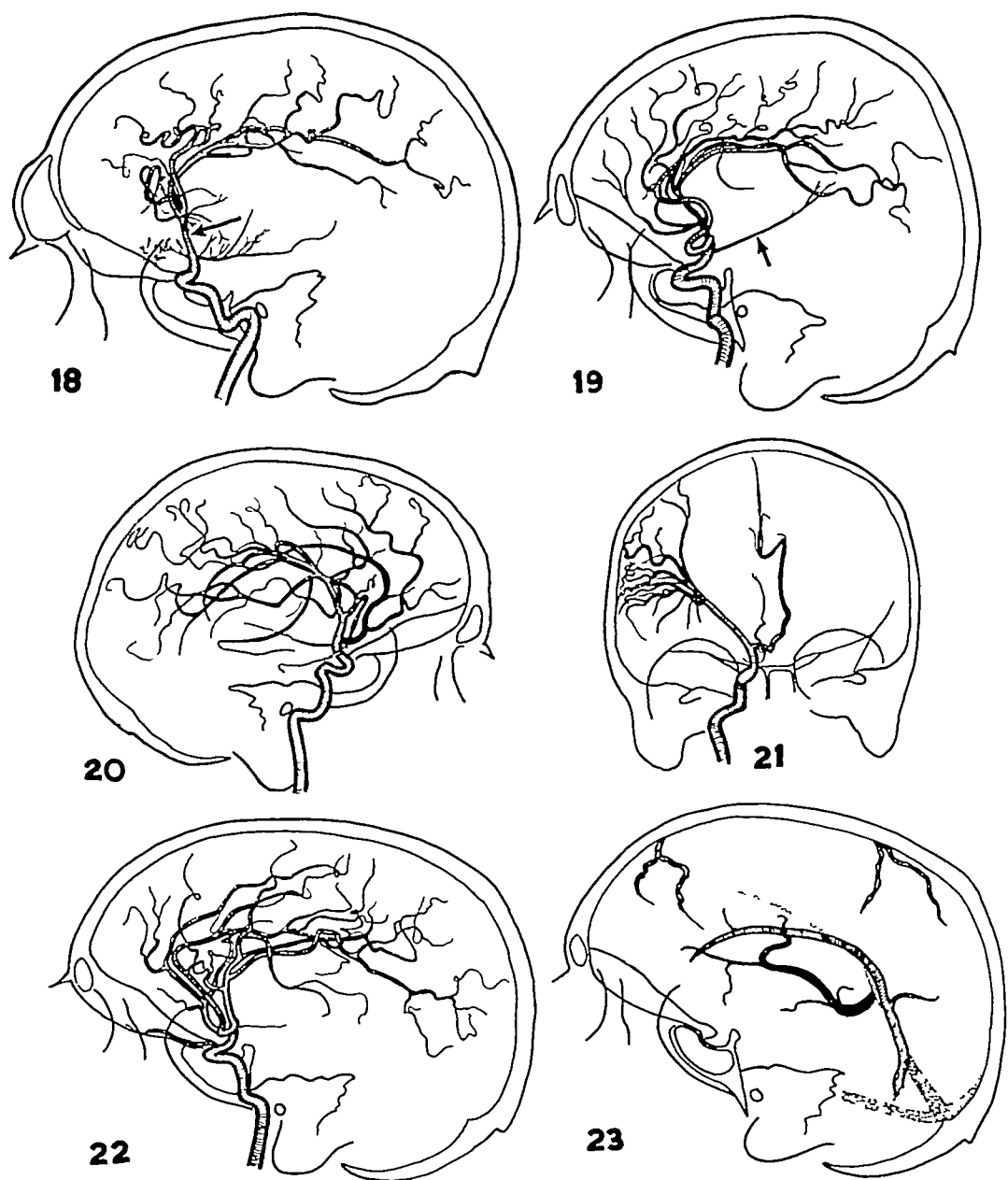
The angiographic picture of temporal lobe tumor is so striking that the diagnosis can be made even by one inexperienced in the interpretation of angiograms. Moreover, excellent films, rich in contrast and detail, are easily obtained in these cases.

Elevation of the sylvian vessels is the pathognomonic sign for temporal lobe tumor. In the lateral view, the arteries

of the middle cerebral group are displaced upwards, in the anteroposterior projection, they appear also shifted medially, away from the bony contour of the temporo-sphenoidal convexity. Thus, the distance between the anterior and middle cerebral arteries is reduced in both the sagittal and frontal plane. The anterior cerebral artery is displaced across the midline without losing its normal tortuousness and without deformation of its frontopolar branch. For descriptive purposes, the temporal lobe tumors will be considered under two headings: tumors of the anterior part and tumors of the posterior part.

**Anterior Temporal Lobe Tumors** This group comprises meningiomas of the middle fossa arising from the lesser wing of the sphenoid and gliomas of the temporal pole extending to the hippocampal uncus.

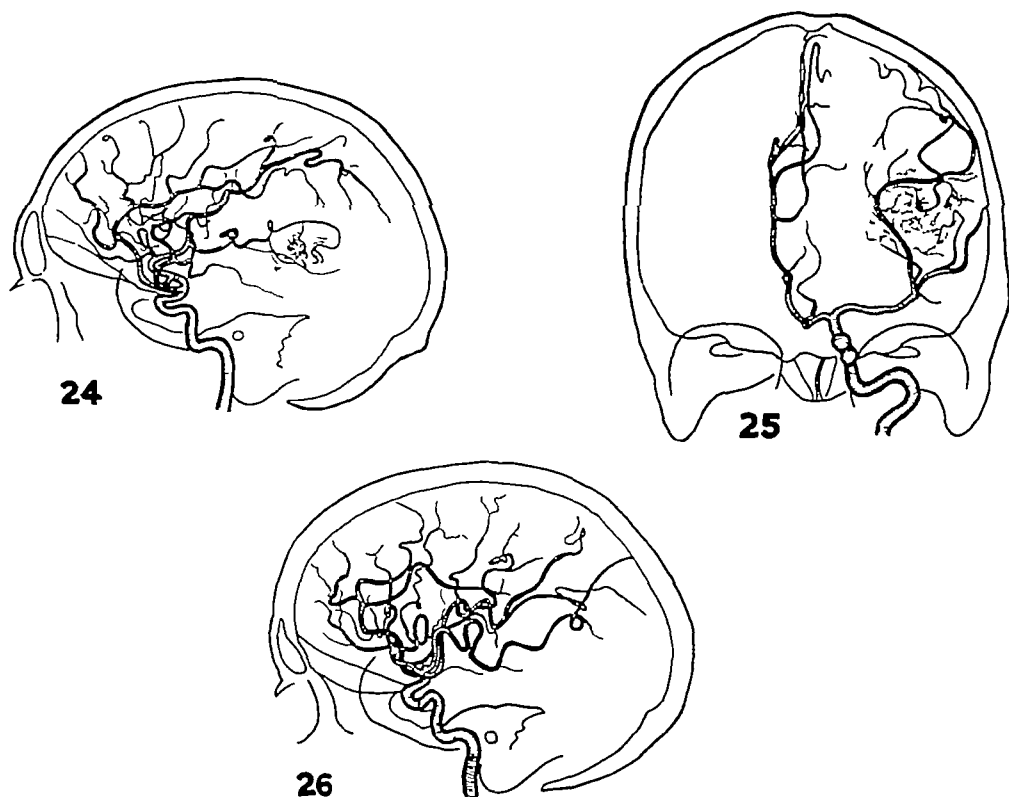
Meningiomas at the inner part of the sphenoidal wing and anterior clinoid process behave like large parasellar tumors and show the corresponding angiographic signs (see above). In addition, they elevate the beginning of the middle cerebral artery. Meningiomas of the external two-thirds of the sphenoidal wing encroach upon the anterobasal part of the temporal lobe and



Figs 18-23 Tumors of the anterior part of the temporal lobe

- Fig 18 Lateral arteriogram of large meningioma of lesser sphenoidal wing Arrow points to site of carotid compression
- Fig 19 Lateral arteriogram of temporal glioblastoma Arrow points to displaced anterior choroidal artery
- Figs 20 and 21 Arteriograms of cystic glioblastoma of temporal lobe, lateral and anteroposterior projections
- Figs 22 and 23 Sarcoma of temporal pole, lateral arteriogram (Fig 22) and lateral venogram (Fig 23)

also, to a variable degree, on the postero-inferior part of the frontal lobe On lateral arteriograms (Fig 18), these cases show the first curve of the carotid siphon widely open or even flattened to 180 degrees, with the supraclinoid segment of the carotid and the middle cerebral artery taking a straight vertical course upwards Occasionally



Figs 24 and 25 Arteriograms of posterior temporal glioblastoma with special vascular pattern, lateral and anteroposterior projections

Fig 26 Lateral arteriogram of occipital glioma

there may be compression or even partial occlusion of these vessels by adjacent neoplasm (Fig 18). The middle cerebral group then makes a rectangular turn, continuing horizontally in a plateau-like fashion, the terminal branches, however, resume their normal diagonal course. On the anteroposterior projection (Fig 7), the elongated suprachinoid portion of the internal carotid appears displaced medially, the bifurcation into the anterior and middle cerebral arteries forms a characteristic "V". On venograms, the superficial sylvian vein and the anterior segment of the anastomotic vein of Labbé may be sharply elevated. Gliomas of the anterior part of the temporal lobe exhibit a similar picture (Figs 20 and 22), although the stretching of the carotid and middle cerebral artery is not as extreme and the backward turn of the sylvian group is more gradual and rounded. Small superficial vessels, the anterior temporal artery or forward branches

of the posterior temporal artery, may be stretched over the convexity of the lobe (Fig 20). If the tumor invades the hippocampal region, the anterior choroidal artery, a fairly constant direct branch of the internal carotid, is considerably stretched and displaced medially and upwards (Fig 19). In anteroposterior arteriograms, again the typical V-shaped angle between the anterior and middle cerebral arteries may be observed (Fig 21). On venograms, the engorged vein of Labbé is elevated in a wide semicircle and may project above the level of the vein of Galen, instead of below, as normally (Fig 23).

*Posterior Temporal Lobe Tumors* Posterior temporal lobe tumors, most of which are gliomas, do not deform the carotid siphon and the first segment of the middle cerebral artery, but they markedly elevate the branches of the sylvian group. On lateral arteriograms (Fig 24) the entire sylvian group forms an arc whose upward

convexity may lie almost at the level of the pericallosal artery. Tumors situated close to the lateral surface of the lobe produce stretching and separation of the angular and posterior temporal arteries and their branches. In the anteroposterior projection, the position of the carotid remains unchanged and the bifurcation into the anterior and middle cerebral arteries has the configuration of a rectangular compressed "U" (Fig 25).

#### 4 TUMORS OF THE OCCIPITAL LOBE

Tumors of the occipital lobe and adjoining posterior inferior part of the temporal lobe show less characteristic angiographic signs, because these regions receive most of their supply of blood from the vertebral system through the posterior cerebral artery, and that vessel is only occasionally demonstrated by carotid injection.

In lateral arteriograms, moderate elevation and forward crowding of the angular and posterior temporal arteries may be seen (Fig 26). The terminal branches of these vessels are definitely spread and distended, as are the arborizations of the posterior cerebral artery, provided that vessel is filled. More anteriorly, the compressed arteries of the sylvian group exhibit a tendency to coil together. On the anteroposterior projection, the midline shift of the anterior cerebral artery is slight or even absent. The vein of Labbé may be shifted downward and anteriorly.

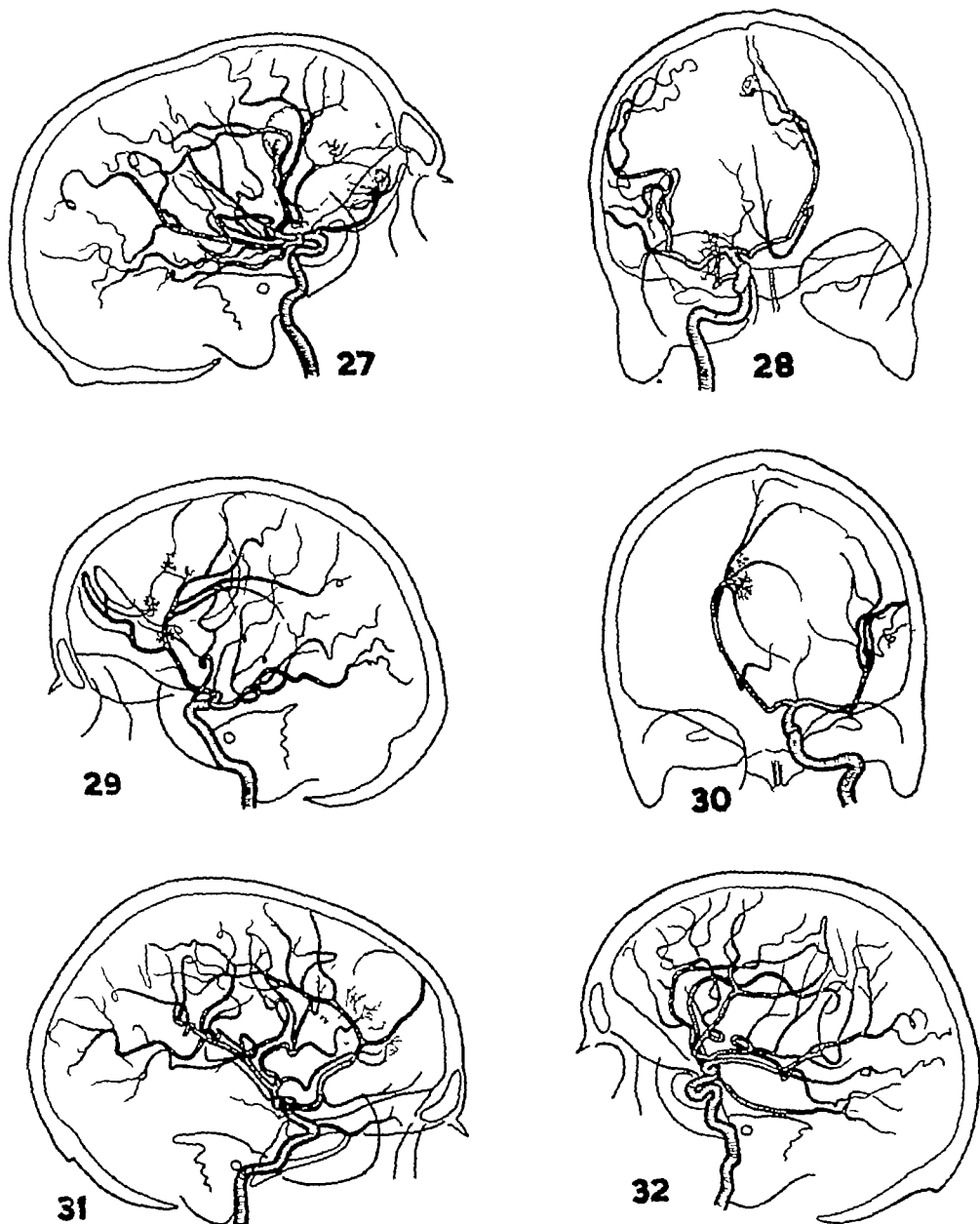
#### 5 TUMORS OF THE FRONTAL LOBE (2, 5)

Space-occupying lesions of the frontal lobe deform to a variable degree the supracallosal segment of the internal carotid artery, the anterior two-thirds of the anterior cerebral artery and its branches, and the beginning of the middle cerebral artery with its frontal ascending (rolandic) branches. The most characteristic sign of all unilateral frontal tumors is the considerable displacement and localized stretching of the anterior cerebral artery to the opposite side. As a rule, this midline shift is more marked in frontal neoplasms than in hemispherical tumors of any other location.

For the purpose of angiographic description, the expanding lesions of the frontal lobe will be divided into the following groups: (a) subfrontal (basofrontal) tumors, (b) prefrontal (polar frontal) tumors, (c) premotor (posterior superior frontal) tumors, (d) frontotemporal (posterior inferior frontal) tumors.

(a) *Subfrontal Tumors* Representative of the subfrontal group are the meningiomas of the olfactory groove. These usually large neoplasms arise from the floor of the anterior fossa and compress the orbital surface of the frontal lobe and suprasellar region; they show more often bilateral than unilateral development. On arteriograms taken in lateral projection, the suprasellar and subcallosal segments of the anterior cerebral artery are displaced upwards and posteriorly, forming an anteriorly concave arc around the lesion (Fig 27). In large tumors, the supraclinoid portion of the carotid and the precallosal knee of the anterior cerebral artery may be pushed backwards. Unilateral olfactory groove meningiomas displace mainly the subcallosal portion of the anterior cerebral artery to the opposite side (Fig 28).

(b) *Prefrontal Tumors* This group comprises mainly astrocytomas and meningiomas (arising from the anterior portion of the falx and superior longitudinal sinus). On lateral arteriograms (Figs 29 and 31), the carotid siphon and the beginning of the sylvian vessels are slightly pushed backwards and downwards. The anterior cerebral artery is displaced backwards so that the curve of the vessel around the knee of the corpus callosum is blunted without losing its forward convexity. The smaller forward branches of the anterior cerebral artery appear distended and spread apart. Much more impressive changes are observed in anteroposterior projection (Fig 30). There is major displacement of the anterior cerebral artery across the midline underneath the free edge of the falx and, in contrast to most other hemispherical tumors, the distance between the anterior and middle cerebral arteries is greatly increased. The subcallosal and precallosal



Figs 27-32. Frontal lobe tumors

Figs 27 and 28 Arteriograms of sarcomatous olfactory groove meningioma, lateral and anteroposterior projection

Figs 29 and 30 Arteriograms of parasagittal meningioma of the prefrontal and premotor regions, lateral and anteroposterior projections. Note special circulation of tumor

Fig 31 Lateral arteriogram of astrocytoma of prefrontal lobe. Note faint special circulation

Fig 32 Lateral arteriogram of parasagittal premotor glioma

portions of the anterior cerebral artery form a smooth round bulge and, due to stretching, the extended frontopolar branch leaves the main vessel without undulations. Diagrammatically, the figure outlined by

the carotid bifurcation, anterior and middle cerebral arteries resembles an open "O"

(c) *Premotor Tumors* Astrocytomas, oligodendrogliomas, and meningiomas are commonly encountered in this location

convexity may be almost at the level of the pericallosal artery. Tumors situated close to the lateral surface of the lobe produce stretching and separation of the angular and posterior temporal arteries and their branches. In the anteroposterior projection, the position of the carotid remains unchanged and the bifurcation into the anterior and middle cerebral arteries has the configuration of a rectangular compressed "U" (Fig 25).

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#### 5 TUMORS OF THE FRONTAL LOBE (2, 5)

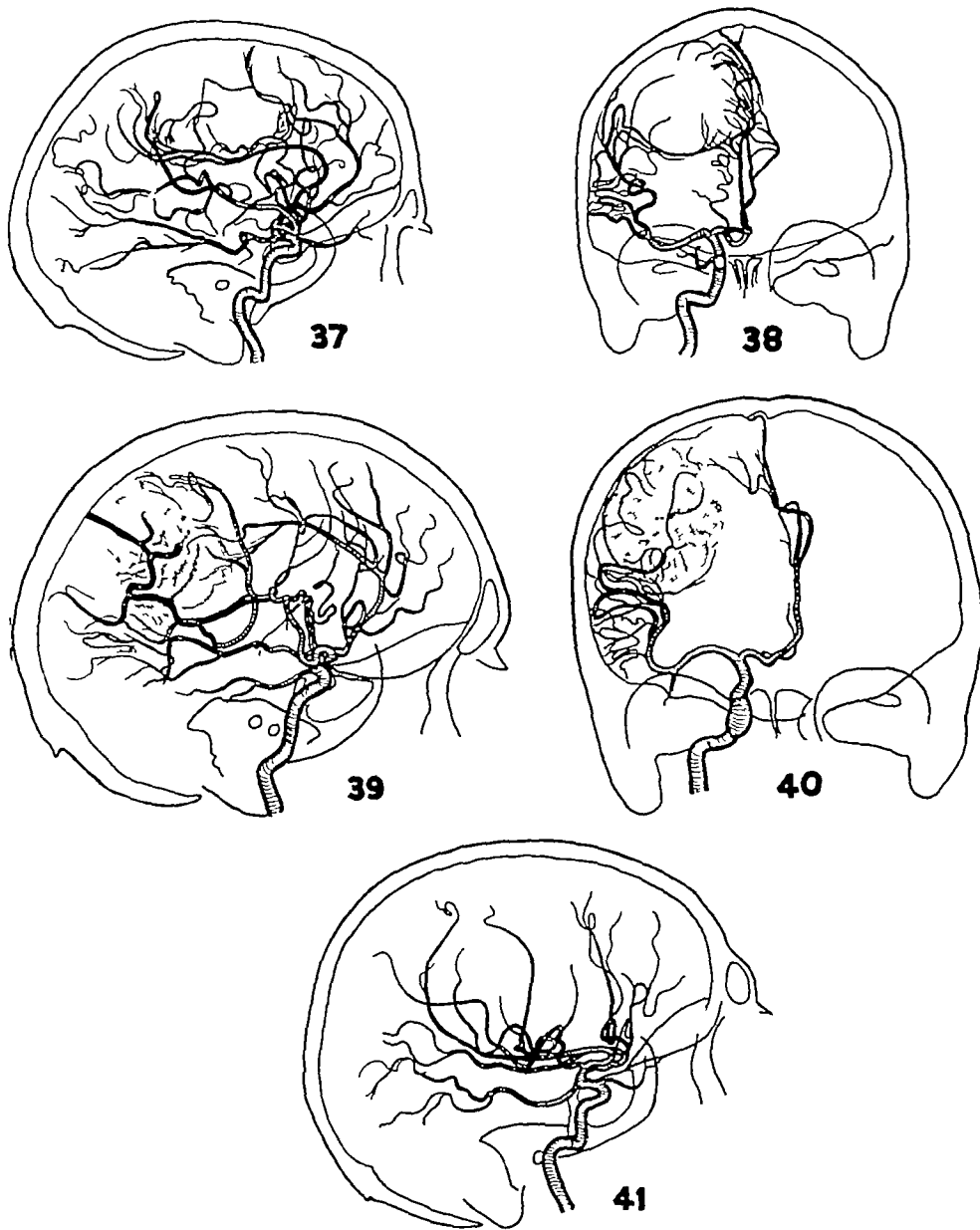
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Figs 37-41 Parietal lobe tumors

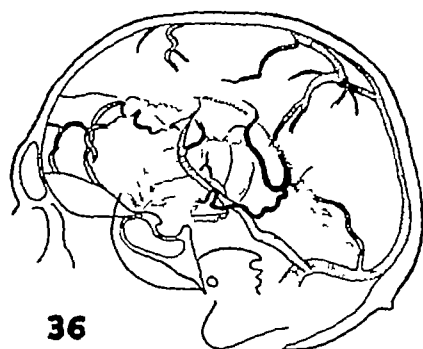
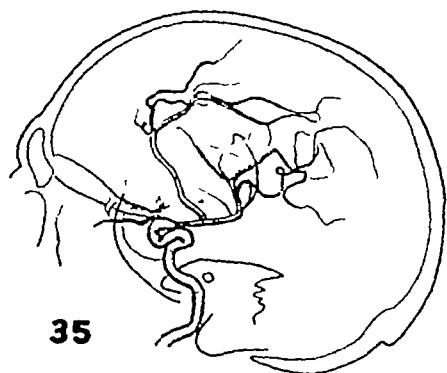
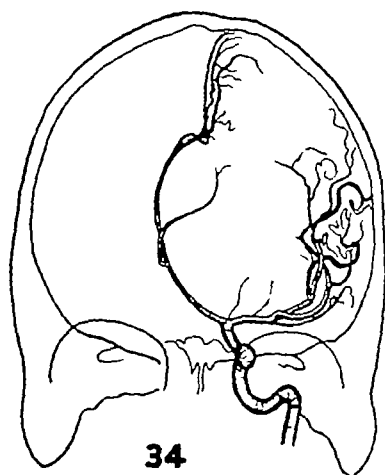
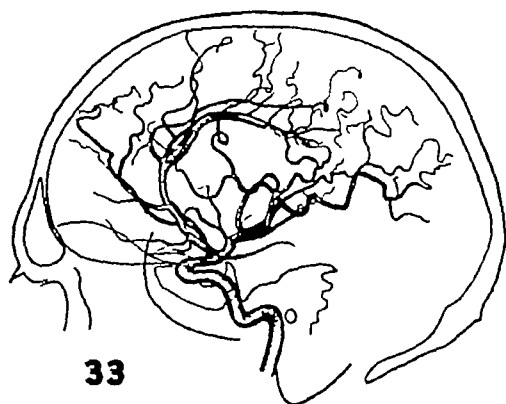
Figs 37 and 38 Arteriograms of parasagittal meningioma of the anterior parietal region, lateral and anteroposterior projections

Figs 39 and 40 Arteriograms of posterior superior parietal glioblastoma with special vascular pattern, lateral and anteroposterior projections

Fig 41 Lateral arteriogram of inferior parietal glioblastoma

and diffuse astrocytomas In the lateral projection (Figs 33 and 35), the supraclinoid portion of the carotid forms with the middle cerebral artery a straight, diagonally ascending line The sylvian group continues in the same direction, or is as often a little elevated as depressed The

ascending frontoparietal artery is markedly stretched, and its two widely separated terminal branches form a triangular pattern Due to the stretching of the sylvian vessels, the origin of the anterior cerebral artery is projected clear from superimposed vascular shadows The pericallosal curve



Figs 33-36 Frontal lobe tumors

Figs 33 and 34 Arteriograms of deep posterior and inferior frontal glioblastoma, lateral and anteroposterior projections

Figs 35 and 36 Meningioma of lesser wing of sphenoid extending under frontal lobe and beginning of sylvian fissure, lateral arteriogram (Fig 35) and lateral venogram (Fig 36) Note special vascular pattern

The carotid siphon, as seen in the lateral projection (Fig 6) is compressed, sometimes forming an apparent sharp angle anteriorly. Instead of following a normal diagonally ascending direction, the initial portion of the sylvian group is depressed, taking a horizontal or even downward convex course. It is important to observe the configuration of the ascending frontoparietal artery. This vessel, which has roughly the shape of the Greek letter  $\psi$  ( $\psi$ ), is difficult to trace in the normal brain, because of its redundancy. In pre-motor tumors, the frontoparietal artery is displaced downward and posteriorly, with its terminal branches separated (Fig 32). The anterior cerebral artery may be de-

pressed in its supracallosal segment and the callosomarginal branches separated if the lesion is in parasagittal location, but the polar vessels show little or no spreading. The angiographic picture revealed by the anteroposterior projection is similar to that of prefrontal tumors, with the exception that the principal midline shift occurs a little higher, at the knee of the anterior cerebral artery, which is projected just below the edge of the falx.

(d) *Frontotemporal Tumors* In this subdivision one observes meningiomas of the lesser sphenoidal wing growing underneath the frontal lobe into the beginning of the sylvian fissure, glioblastomas of the posterior inferior frontal and opercular regions,

tomas, depress considerably the sylvian vessels but displace little or not at all the anterior cerebral artery in the vertical plane. In the lateral projection, the sylvian group appear compressed and take an unusual horizontal or downward convex course instead of the normal diagonal fan-like arrangement (Fig. 41). The terminal branches (anterior and posterior parietal and angular arteries) leave the sylvian group almost at right angles and ascend vertically, being widely separated from each other. On venograms, some separation of the superior cerebral veins may be noted, and the vein of Labbé may be displaced downwards.

## 7 TUMORS OF THE BASAL GANGLIA AND THALAMUS

It is sometimes difficult to differentiate clinically tumors of the parietal or parieto-temporal regions from those of the basal ganglia and thalamus. These latter deep lesions are unquestionably best demonstrated by ventriculography, yet a presumptive diagnosis of tumor of the basal ganglia or thalamus can be made by angiography when the following findings are present:

There is evidence of moderate hydrocephalus (see page 322), with the anterior cerebral artery remaining in its normal midline position (Fig 44). In certain lesions of the basal ganglia, however, this vessel describes an unusual forward and upward bulge similar to that observed in posterior inferior frontal tumors (Fig 42). If the small arteries of the anterior perforate space (lenticulostriate and lenticulo-optic vessels) are visible in the anteroposterior film, they appear stretched and displaced laterally (Fig 44). The anterior choroidal artery may be seen displaced downwards

and posteriorly, describing a semicircle around the optic tract and pulvinar (Fig 43). This is almost a pathognomonic sign for thalamic neoplasm, but unfortunately the choroidal vessel is not always visible. According to Egas Moniz (4), the internal cerebral vein and great vein of Galen may be elevated in thalamic tumors, however, we have usually found these veins in normal position.

## SUMMARY

The displacement of intracranial blood vessels was studied in 136 cases of space-occupying intracranial lesions by means of carotid (or vertebral) angiography

The method, which has proved to be reliable and safe, is indicated in certain expanding lesions of the base of the brain and skull, and of the cerebral hemispheres, and is of special value for the differentiation of neoplasms and vascular processes

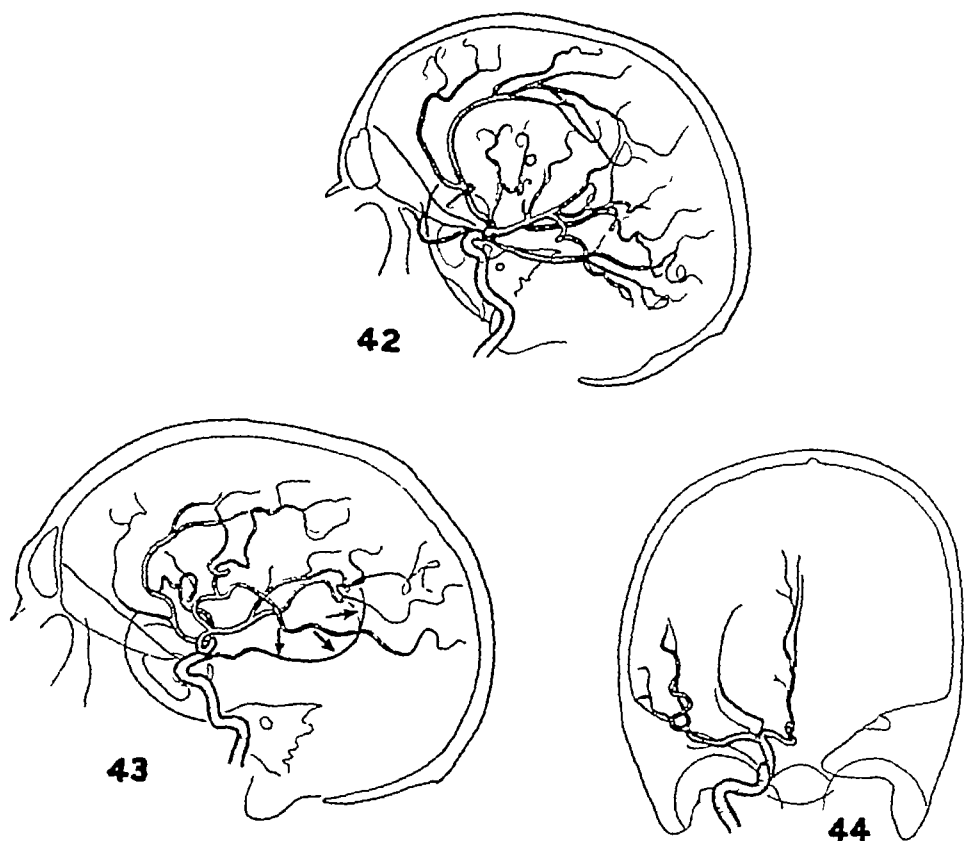
The general angiographic changes encountered in expanding intracranial lesions and internal hydrocephalus are discussed

A detailed description of the vascular deformities is given in lesions of the base of the brain and skull, various parts of the hemispheres, basal ganglia, and thalamus

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Figs 42-44 Tumors of the basal ganglia and thalamus

Fig 42 Lateral arteriogram of cystic glioma of basal ganglia and thalamus

Figs 43 and 44 Arteriograms of glioblastoma of thalamus, lateral and anteroposterior projections  
Arrows point to the displaced anterior choroidal artery

of the anterior cerebral artery is elevated and widened (similar to the picture seen in hydrocephalus). In the anteroposterior projection (Fig 34), the anterior cerebral artery exhibits the bulge across the midline typical of frontal tumor, the middle cerebral artery may have a tendency to diagonal elevation, as is observed in tumors of the temporal lobe. On venograms, the internal cerebral vein may appear displaced upward and posteriorly (Fig 36).

## 6 PARIETAL LOBE TUMORS (2)

Space-occupying lesions of the parietal lobe depress the sylvian vessels and the pericallosal artery. Thus, the distance between the anterior and middle cerebral systems appears to be reduced in the lateral projection (Figs 37). There is only moderate midline displacement of the posterior

part of the anterior cerebral artery because the resistant falx yields little to pressure, yet there may be characteristic notching of the anterior parts of that vessel underneath the falx (Figs 38 and 40). In parietal tumors, we have relatively often observed poor filling of the terminal cortical arteries. Presumably, the intravascular pressure of the injection is insufficient in the smaller branches to overcome the compression exerted by the tumor.

Neoplasms of the superior parietal region (parasagittal meningiomas, gliomas) (Fig 37) depress and sometimes separate the pericallosal and callosomarginal arteries. The vessels of the sylvian group may not be much deformed, except for separation of the terminal branches of the posterior parietal and angular arteries (Fig 39). Inferior parietal tumors, commonly glioblas-

conforming essentially to the description given above. It should be pointed out, however, that a number of cases of a rather similar nature, histologically, have been recorded, varying chiefly in the fact that metastases have been found, either in the bronchial lymph nodes or disseminated widely throughout the body. Since this particular lesion has shown all of the characteristics of malignancy, it usually has been described as an alveolar-cell carcinoma (6, 10). The clinical course in many of these patients has been somewhat different than in the benign form of the disease, the metastatic involvement often influencing the clinical symptoms and progress to a considerable degree. Neubuerger and Geever (7) made no distinction between the two forms in their review and summarized the records of 24 cases which they believed fell into this category, which they termed alveolar-cell tumor. It has seemed better to us to limit our discussion to those lesions more closely approaching the descriptions given by Bonne and Sims. This does not deny the similarity of origin of a benign and a malignant form but does imply a possibly different clinical progression and a somewhat different end-result on pathologic study of autopsy material. Borderline cases, such as the one described by Sweany (10) are difficult to classify. Sweany's patient had a solitary metastatic nodule in one bronchial lymph node. Other cases of this type are mentioned in Neubuerger and Geever's review (7). The occurrence of areas of carcinomatous change in what is otherwise a benign appearing lesion, without demonstrable metastases (Cases I and III), adds further difficulty to attempts at strict classification.

Of interest in this connection is the statement that metastases have never been found in jaagsiekte except in one specimen reported by Aynaud (1). Just what, if any, relationship exists between jaagsiekte and pulmonary adenomatosis in man remains to be determined. Investigations to determine the infectiousness of the disease and the presence of a virus have been few, and

thus far fruitless. Indeed, the very difficulty in recognizing the nature of the process prior to microscopic examination of fixed specimens has largely precluded any attempt at such study. Sims, making use of frozen sections at the time of autopsy, realized the similarity of the lesion to that described as occurring in sheep. Attempts at reproducing the lesions in rabbits, monkeys, and guinea-pigs failed. Wood and Pierson had established the diagnosis in their patient prior to death, on examination of a lobe removed for a lung abscess. The patient died after the disease had become generalized. Studies for identification of a virus were under way at the time of their report.

The pathologic lesion consists typically of scattered nodules of consolidation on the cut surfaces of the lungs. These are usually mistaken for patches of gray pneumonia until microscopic examination reveals that they are caused by the localized occurrence of an abnormal lining in the alveoli. This lining is made up of either low or moderately high cuboidal epithelium, the cells of which tend to be slightly pear-shaped and to form papillary projections into the alveolar spaces. Many investigators regard them as being derived from the alveolar covering cells, but there is some evidence, as seen in our cases, that they come from bronchial epithelium. The alveolar walls in these nodules are thickened and edematous, and the connective tissue is increased.

#### CASE REPORTS

CASE I (previously reported by Sims). C. H., a white male, 42 years of age, complained of a cough of two years duration. A year prior to admission, rheumatism involving many joints developed. For the past year the cough had been productive of a frothy white sputum amounting to about a cupful a day at the time of admission. Other complaints were afternoon fever, progressive weakness, pains across both sides of the chest upon coughing, shortness of breath even on slight activity, anorexia, and considerable gaseous distention. There had been a 40-pound weight loss during the past year.

Physical examination showed the patient to be very weak, coughing frequently, and raising a watery sputum. The skin was hot and dry. The right side of the chest was smaller than the left and expanded poorly. Dullness was present over the right side of

# Pulmonary Adenomatosis<sup>1</sup>

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PULMONARY adenomatosis in man is a rare disease of the lungs characterized by the development of multiple nodular adenomatous tumors or by a diffuse hyperplasia of the pulmonary alveolar lining cells. Typically the disease spreads throughout both lungs, interfering greatly with the gaseous exchange in the alveoli and eventually causing death, often with a terminal pneumonia and without the occurrence of metastases elsewhere in the body. The lesion has stimulated considerable speculation and interest, chiefly among pathologists, because of its close resemblance histologically to an infectious disease of the lungs which is widely encountered in sheep and to a lesser degree in some other animals.

The present report is made for the purpose of reviewing the pathologic and clinical aspects of the disease, and more particularly the roentgen features, and to report our experiences in four cases, three of which have not previously been recorded in the literature. A fifth case will be discussed briefly because of interesting findings on histologic study.

Writers on the subject of human pulmonary adenomatosis have been impressed by its resemblance to the condition found in sheep and known variously as jaagsiekte, epizootic adenomatosis, Montana progressive pneumonia of sheep, etc. (3, 9, 12). This disease has been endemic in many areas throughout the world and has been the subject of considerable study. There is sufficient evidence to indicate that it is of infectious origin, though the causative organism has not as yet been found. That a virus is responsible is the opinion of those who have made extensive studies.

In 1939, Bonne (3) described a peculiar tumor-like process of the lungs found in a

30-year-old Chinese, characterized by a diffuse involvement of the alveolar walls of most of both lungs and a replacement of the alveolar cells by darkly staining cells in which mitoses were frequently seen. These cells lined the alveolar sacs and often protruded into their lumina forming papillary buds. There was practically no invasive growth or necrosis, and no metastases were present. Bonne noted the close resemblance to jaagsiekte in sheep and commented on the possible relationship. He did not believe the term carcinoma should be applied to the tumor in his case and suggested that it be called carcinosis. Previous to this report, Dungal (4), who had been studying the condition in sheep, had reviewed the literature in a search for cases of adenomatosis in man and found instances reported by Helly (1907), Löhlein (1908), and Oberndorfer (1930). Of these, the one reported by Helly more closely resembled the condition described. In Oberndorfer's case, metastases were present, Löhlein's patient had a single apple-sized tumor in the lower lobe of the right lung.

In 1943, Sims (9) reported a case which he classified as pulmonary adenomatosis (Case 1 in our series) and also stressed the resemblance to jaagsiekte. He reviewed the entire subject in some detail and concluded that the cases reported by Bonne, Helly, and himself were identical. Subsequently Bell (2), and Wood and Pierson (12) have described quite similar cases and Taft and Nickerson (11) have presented two. For a more detailed discussion and review of the literature, the reader is referred to these articles.

To avoid confusion in the present report, reference will be made only to those cases

<sup>1</sup> From the Departments of Radiology and Pathology, The University of Wisconsin Medical School, Madison Wis. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago Ill., Nov. 9-10, 1945.



Figs 2 and 3 Case II Fig 2 is the admission roentgenogram Note the similarity to Fig 1 (Case I) Three months later (Fig 3) the disease had undergone a general advance on the right side

the day of admission, blood in the sputum was noted for the first time The pertinent physical findings had not changed a great deal as compared with the first admission except for an increase in the chest signs and the presence of a white blood cell count of 32,400 with 93 per cent neutrophils

*Roentgen examination* of the chest (Fig 3) revealed no clearing in the right upper lobe consolidation and a general advance in the process throughout the lung The evidence of pulmonary congestion persisted A diagnosis of pulmonary neoplasm was considered the most probable explanation of the right-sided process

The temperature on admission was  $100.2^{\circ}$  rectally The patient failed progressively and died on Aug 4, 1943, four days after admission

The *autopsy* findings were as follows

*Gross* In the *right lung*, there were several bronchiectatic abscesses, the largest, in the lower lobe, measuring 7 cm in diameter Extensive bronchopneumonia and necrosis were present The entire lower lobe of the *left lung* was granular to the touch, and scattered over it were nodules about 2 mm in diameter Bronchiectasis was also present in the lower lobe

*Microscopic* Extensive acute inflammation and necrosis were found Scattered over both lungs were areas of adenomatosis of varying sizes up to several millimeters in diameter The structure of the growth varied greatly in various sections In some parts it had grown rapidly and extended widely, becoming necrotic locally In others it was in discrete areas, microscopic in size and sharply limited (Fig 1) In some of these nodules there were stretches of ciliated columnar epithelium entirely continuous



Fig 4 Case II A sharply demarcated nodule of adenomatosis  $\times c 35$

with the remaining cubical epithelium In the larger nodules there was a definitely invasive tendency, although one would hesitate to render a diagnosis of frank carcinoma



Fig 1 Case I Dense consolidation on the right suggesting extensive pneumonia. Scattered areas of density in the left mid and basal lung field. Autopsy showed adenomatosis and pneumonia.

the chest except at the extreme apex posteriorly. Breath sounds were tubular over the right middle lobe and were decreased generally posteriorly. Many fine moist râles were heard at the apex in the right lung and throughout both bases. An extreme degree of clubbing of the fingers and toes was noted.

Urine and blood examinations were essentially negative, as was the blood Wassermann reaction. Two sputum examinations were negative for acid-fast bacilli. The temperature at the time of admission was  $100^{\circ}$ , but there was progressive rise during the following days to a high of  $106^{\circ}$ . The patient became increasingly ill and died five days after admission.

*Roentgen examination* of the chest the day after admission (Fig 1) showed a soft patchy mottling throughout the left middle and lower lung field, although no large areas of consolidation were present here. The left dome of the diaphragm was smooth and the sulcus was clear. On the right side there was a great deal of soft opacity, almost completely obscuring the aerated lung except for some air in the apex and peripheral base. The peripheral aspect of the diaphragm was visible and the sulcus was clear. The opinion was expressed that the process was an extensive pneumonia with the major involvement on the right.

The autopsy findings were as follows:

*Gross* In the right lung there was some fine granular fibrinous exudate on the surface of the lower lobe. Fibrous adhesions were present at the apex and between the lobes. The surface was irregularly nodular to the feel, the nodules being quite large.

The cut surface in most areas was pinkish yellow, but in the lower lobe there was extensive fine red pin point marking. Only small areas of air-containing lung tissue remained. The left lung was air-containing except for the posterior part, which showed various grades of consolidation. There was congestion throughout.

*Microscopic* Scattered areas of acute pneumonia were found, and extensive patches of adenomatosis. In some portions this lesion appeared to have undergone malignant change, as there was to be seen an obvious transition between typical adenomatosis and a squamous cell type of carcinoma.

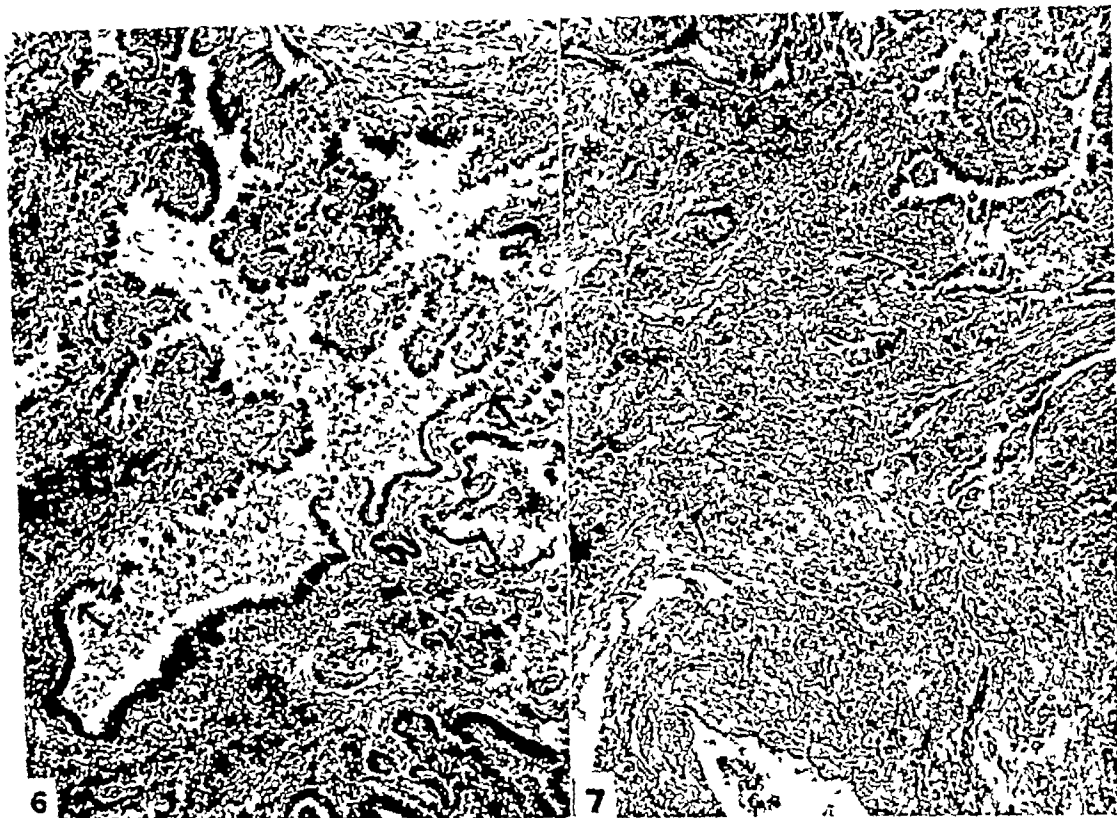
**CASE II** I B, a 68 year-old white woman, on her first admission to the hospital, on May 11, 1943, had as a chief complaint shortness of breath of six to eight years duration. She had been at bed rest most of the time for the six months previous to admission, with marked shortness of breath on the slightest effort. There was a chronic cough with expectoration of small amounts of frothy white sputum. A weight loss of 40 pounds had occurred in the previous six months. Other complaints included the presence of a lump in the right side of the neck and chronic constipation.

On physical examination enlargement of the thyroid was found. There was a lag in expansion of the right side of the chest, with dullness over the right upper chest anteriorly. Bronchial breathing was present in that area with many fine râles. The heart was enlarged and the rhythm extremely irregular, with a systolic murmur at the apex, transmitted to the axilla. The blood pressure was 162/72. Urinalysis was normal. The blood count showed 14.6 gm. of hemoglobin, 4,350,000 red cells, and 10,400 white cells. The electrocardiogram demonstrated auricular fibrillation and advanced myocardial changes.

*Roentgen examination* of the chest (Fig 2) was reported as showing the heart to be moderately and generally enlarged and the aortic arch increased slightly in caliber. There was a good deal of soft truncal accentuation in the lung fields. The right upper lobe was densely consolidated in its inferior two-thirds, and there was homogeneous density running down along the medial lung field toward the base on this side. The sulci were clear. These changes were considered to be due to pulmonary congestion plus pneumonic consolidation on the right. Clinically, there was little to support the diagnosis of pneumonia, and the nature of the right lung consolidation was the subject of considerable speculation. The patient was discharged with the diagnosis of arteriosclerotic heart disease with cardiac enlargement, mitral insufficiency, and auricular fibrillation.

The patient was admitted the second time on Aug 1, 1943. Her physical condition had deteriorated during the interval. She complained of a great deal of pain over the liver area. Her color frequently became quite cyanotic. Cough had increased and she was raising considerable thin, watery sputum. On





Figs 6 and 7 Case III In Fig 6, the arrows indicate points of transition between columnar (bronchial) epithelium and the irregular cubical epithelium characteristic of adenomatosis In Fig 7, a small area of adenomatosis is seen in the upper right-hand corner, with a transition below to carcinoma  $\times 70$

few teaspoonfuls of clear sputum were raised There had been a weight loss of 45 pounds

On physical examination the respirations were found to be 50 per minute, the temperature  $99.4^{\circ}$ , and the pulse rate 128 The patient became cyanotic during fits of coughing Examination of the chest revealed bronchial breathing throughout both sides with fine râles and dullness in the lower thirds

The laboratory examinations included a negative serologic test and urinalysis, hemoglobin was 14.8 gm., red cell count 4,600,000, white cell count 11,000 No tubercle bacilli were found in the sputum or gastric contents and the tuberculin test was negative

*Roentgen examination* of the chest (Fig 8) demonstrated a slight widening of the upper and central mediastinal shadow Aeration was poor in both lung fields There were a coarse, stringy density and soft, patchy infiltrations throughout both lungs The extreme apices were somewhat less involved, although not entirely clear In differential diagnosis consideration was given to sarcoid, Hodgkin's disease, and carcinomatosis Subsequent examinations showed only a slight advance in the disease during the following six weeks

Because of the great respiratory difficulty, nasal administration of oxygen was begun immediately on

admission and continued most of the time until death Roentgen therapy was given to the mediastinum, three doses of 200 r each to an anterior and a posterior field The course in the hospital was almost steadily retrogressive, and death occurred on Sept 18, 1945, about seven weeks after admission

The autopsy findings with reference to the lungs were as follows

*Gross* There was induration of the right upper lobe, the surface of which had a nodular appearance. Areas of consolidation were scattered throughout the right lung In the left lung generalized congestion was present, with patchy areas of consolidation

*Microscopically* there were extensive edema and patchy areas of acute and organizing pneumonia Many tumor alveoli were seen, lined with cubical epithelium These appeared in some areas to be entirely benign, while in others there was much more active growth giving the impression of malignancy

CASE V G G, a 60-year-old male, entered the hospital on Oct 20, 1943, with complaints referable only to the abdomen He had had a gallbladder drainage one and one-half years before, with relief of symptoms for one year Lately there had occurred jaundice and a return of right upper quadrant pain



Fig 5 Case III The large mass on the right was a squamous-cell carcinoma. The lesions of adenomatosis were widespread at autopsy but can hardly be recognized as such in the roentgenogram

An accessory finding of possible interest was a benign polyp of the descending colon, 1 cm in diameter

CASE III G H, a 76-year-old white male, complained chiefly of inability to walk. Four months prior to admission he stated that he had contracted the "flu," which first affected the respiratory tract and later spread to the gastro-intestinal tract. A month later, pneumonia developed and sulfonamide therapy was instituted. One month before admission there were several attacks of localized pain in the neck and between the shoulder blades. This continued and there developed radiating pain into both arms, occasionally necessitating opiates for relief. Three weeks prior to admission the patient experienced numbness, weakness, and loss of function of the right leg, followed in one week by the same difficulty on the left side. This numbness and paralysis had progressed upward to the abdominal region. There had been, for several years, symptoms suggestive of prostatism. The patient had a loose cough and pain in the chest on coughing.

Physical examination revealed decreased hearing bilaterally, slight cardiac enlargement, a blood pressure of 90/50, and a right indirect inguinal hernia. Neurological examination showed weakness of both arms, areflexia in the abdominal region and both lower extremities, and inability to move either leg. There was loss of sensation below the approximate level of the eighth thoracic segment.

The urine was normal, the blood count showed a hypochromic anemia with a hemoglobin of 11.8 gm, red cells 3,640,000, white cells 13,400.

Roentgen examination of the chest (Fig 5) showed a normal cardiac shadow. The aorta was moderately sclerotic. In the left central lung field was a small amount of fibrosis and a calcified nodule about a centimeter in diameter. There was an apical scar. On the right side was a rounded mass in the central lung field posteriorly, extending from the seventh to the ninth interspace and laterally about two-thirds the distance to the chest wall. In addition, there were irregular fibrous density in the subclavicular region and pleural thickening at the peripheral base, with a partially obliterated sulcus. The impression given was that of scattered areas of tuberculous fibrosis plus a tumor on the right, most likely a bronchiogenic carcinoma. Roentgenograms of the spine showed only some senile osteoporosis and hypertrophic change, and an oil myelogram revealed no lesion. Roentgen therapy was started to the chest and the dorsal spine, but on the sixth day the patient's general condition became so poor that it was discontinued. He became weaker and was unable to expectorate the increased tracheobronchial secretion. Death occurred eight days after admission.

Autopsy revealed the following pertinent findings.

**Gross Right lung** Fibrous adhesions were present, partly obliterating the right pleural cavity. The lower part of the middle lobe and the upper part of the lower lobe were occupied by a large, lobulated, sharply demarcated mass with a necrotic center. The rest of the lung showed localized collapse, edema, and congestion. A large apical scar was present in the upper part of the upper lobe showing some encapsulated caseous material. **Left lung** There were localized edema, congestion, and patchy consolidation.

**Microscopic examination** revealed an extremely varied picture of hyperplasia of the bronchial epithelium. In some areas there was merely overgrowth of this epithelium, with adenomatous structure. In others, there was a rather abrupt transition from ciliated columnar epithelium to somewhat irregular cubical epithelium, and the picture was closely similar to that described as pulmonary adenomatosis (Fig 6). In apparently continuous transition there was a change in still other areas to frank adenocarcinoma (Fig 7). Another variation was furnished by the presence in one area (the lobulated mass described above) of a squamous-cell carcinoma, entirely different in structure from the adenocarcinoma. This tumor had metastasized to the local lymph nodes.

CASE IV F S, a white male vending machine operator, aged 52, was admitted on July 26, 1945, complaining of shortness of breath of about two years duration. This had become progressively severe during the last seven months. Three months before admission thyroidectomy had been done, without relief. At the time of admission respirations were gasping in character even when the patient lay quietly in bed. Slight effort greatly increased the dyspnea and led to coughing spells during which a

streaked sputum was seen only during the terminal stage, when infection may have been a factor in its production (hemorrhagic pneumonia). The expectoration of large amounts of mucoid sputum also has a sound basis as revealed by the study of gross and microscopic specimens and can be explained by the tendency of the abnormal cells to produce mucus. Mucus production is said to have been less pronounced in those cases which have shown metastases

four months, and two years, respectively. This corresponds fairly well with cases reported by others.

A review of the roentgenograms of our cases, those reproduced in the literature, and the descriptions given in the remainder reveals two main types of shadow formation, neither of which, by itself, is in any way characteristic. In one group the lesions are manifested by an area or areas of homogeneous density resembling in most features



Fig 8 Case IV Widespread patchy, infiltrative densities throughout both lungs, with general loss of aeration. Fluoroscopically, limited movement of the diaphragm and poor cardiac pulsations were noted. Autopsy revealed adenomatosis and some pneumonia.

The remaining symptoms—loss of weight and strength, fever, anorexia, etc.—do not appear to have any diagnostic importance since they are common to many diseases.

The number of cases available for study is too small to determine the age and sex incidence with any degree of accuracy. Most cases have occurred in middle-aged and elderly persons, in other words, in the carcinoma-age period. The duration of the disease has generally been a matter of months or even years. In our four cases the duration of symptoms from the time of onset to death was two years, seven years,

that caused by pneumonic consolidation (Figs 1 and 2). These areas of density do not, as a rule, follow a lobar distribution. They often are bilateral and extensive and may involve most of the lung fields. Signs of atelectasis have not been a prominent feature. If the patient is first seen during the terminal stage of the disease, the diagnosis of pneumonia is more likely to be made, since the clinical signs of infection are encountered frequently at that time. Earlier, the diagnosis of bronchiogenic carcinoma might well be entertained if the involvement is limited to one lung or a part

There were no complaints referable to the chest. A cholecystostomy was done on Oct. 27, 1943, but the patient did poorly and died on Nov. 3.

A roentgenogram of the chest revealed nothing abnormal except some adhesions in the left costophrenic sulcus.

At autopsy, a carcinoma of the pancreas was found, with metastases to the liver, gallbladder, and adjacent areas. In the lungs there were bronchiectasis, atelectasis, emphysema, and acute and organizing pneumonia. One small localized area, found only on microscopic examination, showed obvious benign proliferation of bronchial epithelium. The other autopsy findings were not relevant.

### DISCUSSION

The histologic study of these cases brings out two points of special interest, illustrated conspicuously in Cases I, II, and III. In Cases II and III there was an intimate relation between the bronchial epithelium and the cellular lining of the adenomatous alveoli. In Case II there were several stretches of ciliated columnar epithelium among the lower cuboidal cells of the adenomatosis. In Case III an abrupt transition from bronchial epithelium to the adenomatous type of lining was seen in spots, as well as a considerable area of hyperplasia of what was obviously bronchial epithelium. It appears from this that the abnormal epithelium of adenomatosis is derived, in some cases at least, from bronchial epithelium.

The second feature of importance is the obvious transition in Cases I and III from adenomatosis to carcinoma. This would indicate that adenomatosis constitutes in certain cases a transitional form between normal lung and carcinoma, and must, therefore, be regarded as a potentially precancerous lesion.

A study of the records and roentgenograms of our own cases and of those available in the literature was made in order to obtain a more comprehensive picture of the disease. In a few instances, the lesions of adenomatosis were found more or less incidentally at autopsy, the patients dying of some other ailment. In the majority, however, pulmonary adenomatosis was the primary disease. The onset usually was insidious, although in several instances it

was accompanied by symptoms of an acute respiratory infection. The two most prominent symptoms were dyspnea and cough, encountered in all cases.

Dyspnea was the first and most distressing symptom in 5 of the 9 cases reviewed and it developed in the remainder during the later stages of the disease. In one of our cases it began six to eight years before admission to the hospital, gradually increasing in severity until the patient finally became bedridden. In another of our patients, dyspnea had been present for two years, becoming more severe in the last seven months, at the time of admission even the effort of talking or of turning over in bed produced severe dyspnea and cyanosis. The reason for the shortness of breath is clear on study of histologic specimens. The widespread alteration of the alveolar walls and replacement of the alveolar cell lining by abnormal cells interferes greatly with the normal exchange of gases. The accumulation of tenacious secretions in the alveoli and bronchi offers an additional hindrance to normal respiration. The dyspnea may be out of proportion to the extent of pulmonary involvement that can be demonstrated roentgenographically. An explanation for this is also found in the study of specimens removed at autopsy. Changes in the alveolar walls may be much more widespread than would be surmised from the roentgenograms. The abnormal cell proliferation lining the alveolar walls is sufficient to prevent adequate gaseous exchange but may not produce much alteration in the roentgenographic pattern of the lungs until complete blockage of the alveoli occurs either due to tumor proliferation or to accumulation of mucus or exudate.

The second symptom common to all was cough. This occurred as an early and prominent complaint in most of the cases reviewed. The cough was productive in all cases, and the sputum invariably is described as thin, watery, frothy, mucoid, and the like. In most instances the sputum was abundant early in the disease, and in the others it became so in the later stages. Frank hemoptysis did not occur, and blood-

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of the lung. The absence of atelectasis might be of value in differential diagnosis, since it is of such frequent occurrence in bronchiogenic neoplasms.

The second form of the disease is manifested, roentgenologically, by the presence of nodular or patchy infiltrative shadows, again often widely disseminated throughout both lungs. The nodules are not sharply circumscribed but have a hazy outline and resemble in many ways the lesions of widely disseminated carcinomatous metastases. Confusion with metastases is likely, and the two can hardly be differentiated solely on the character of the roentgen shadows in the lungs. The lesions of sarcoid also may resemble this form of pulmonary adenomatosis. Pulmonary sarcoid, however, usually is a benign disease as compared to adenomatosis, the patients, often showing little in the way of constitutional reaction in spite of widespread pulmonary changes. In those cases in which the disease does progress and eventually cause death, the distinction would be difficult to make on roentgen evidence alone. Hodgkin's disease occasionally causes widespread infiltrations in the lungs without much mediastinal lymphadenopathy. If there are no peripheral nodes available for biopsy, a trial of roentgen therapy would seem to be indicated and should prove of considerable value in differential diagnosis. This was done in Case IV of our series. It should be possible to exclude silicosis on the basis of the history and the character of the clinical complaints. The type of lesion under consideration is not ordinarily produced by tuberculosis, but, since the clinical picture may suggest it, studies for tubercle bacilli may be necessary in order to exclude it with reasonable certainty. The same is true for fungus infections.

A combination of massive areas of consolidation and nodular infiltrations has been met with in some cases, changes which are likely to be interpreted as carcinoma of the lung with metastases.

*In summary*, there is little in the single roentgen observation of a patient with

pulmonary adenomatosis that can be considered characteristic of the disease. The shadows produced can be caused by a number of other conditions, and the outlook for eventually establishing definite roentgen diagnostic criteria seems remote. Correlation of the clinical picture with the roentgen evidence may, however, give a clue as to the presence of the disease. Given a middle-aged or elderly patient complaining of severe dyspnea not readily explainable on other grounds, who has a productive cough with abundant thin mucoid sputum and no blood, who shows a slow progressive decline over a period of months, with roentgen changes in the chest such as have been described above, pulmonary adenomatosis should certainly be among the diagnostic considerations. At the present time such a diagnosis is of purely academic interest, since the disease has been fatal in all cases.

Neuburger and Geever (7) suggest that lobectomy or pneumonectomy might be indicated if the disease could be recognized early enough before it had spread widely. This was done in the case reported by Wood and Pierson, but the patient succumbed to the disease, with the lesions becoming generalized.

The main interest in earlier recognition or at least suspicion, of this disease would seem to lie in the direction of aiding efforts at determining whether a virus is responsible, establishing the relationship to jaagsiekte in sheep, and in related studies. If the disease is to be recognized prior to autopsy, roentgen examination will play some part in its detection. It is to be hoped that, with the accumulation of more cases in the future, a better understanding of the clinical and roentgen aspects will be available.

NOTE. Since the completion of this paper we have seen an additional case of pulmonary adenomatosis in which the diagnosis was made correctly prior to autopsy on the basis of the clinical and roentgenologic criteria given above. This will be the subject of a later report.

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and a constant pressure of 15 pounds, it is possible to inject 25 c c of the opaque substance per second, the speed of injection being modified according to the blood pressure and vascular condition of the patient. The first film is taken when 40 c c of the opaque substance have been injected and a second one immediately afterwards, using a fast film changer. When the injection is complete, the trocar is withdrawn, a suture is placed in the adventitia of the artery, and the wound is closed. The patient should receive a pheno-



Fig 3 Stenosis and dilatation of the abdominal aorta, with narrowing of the iliac arteries and sacculated aneurysm at the end of the common iliac

barbital the night before and morphine hypodermically one hour prior to the injection, in order to obtain relaxation and avoid pain.

Among the inflammatory lesions of the abdominal aorta and iliac arteries, syphilitic arteritis occupies first place because of its frequent occurrence. It may produce dilatation or obliteration of the arteries. In dilatation the muscular and elastic coats of the artery are destroyed, leading to the



Fig 4 Aorta dilated, elongated, and tortuous. Large ovarian cyst

formation of the different types of aneurysm. As examples we have the following histories:

S. B., white, 52 years old, married, had untreated syphilis; the Kahn and Meinicke tests were markedly positive. The abdominal aorta was palpable, and there was a systolic murmur. Arteriography shows uniform dilatation of the abdominal aorta with a small sacciform aneurysm at the end of the left common iliac (Fig 1).

R. G., 30 years old, gave a history of slight epigastric pains for six months with no relation to meals, then, sudden epigastric pain of increasing intensity, with radiation toward both lower extremities. The Kahn and Meinicke tests were strongly positive. Palpation revealed a pulsating epigastric tumor the size of a grapefruit. The clinical impression was a tumor of the head of the pancreas. Aortography showed dilatation of the iliac arteries and a large canalized aneurysm of the abdominal aorta. This diagnosis was confirmed surgically, and arteriotomy of both iliac arteries was performed (Fig 2).

In the obliterative type of arteritis there is a thickening of the arterial wall, especially the intima, with reduction of the

# Retrograde Abdominal Aortography

A Contribution to the Study of the Abdominal Aorta and Iliac Arteries<sup>1</sup>

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**P**LAIN X-RAY examination of the abdominal aorta and iliac arteries offers information only in the presence of calcification of the arterial walls or calcified aneurysms. Retrograde abdominal aortography is a simple method for the study of

three seconds. A tourniquet is applied at the root of each lower extremity in order to prevent the passage of the contrast medium into their arteries. The Trendelenburg position may be required in certain cases.

To avoid changes in pressure when the



Fig 1 Uniform dilatation of the abdominal aorta with a small sacciform aneurysm at the end of the left common iliac

Fig 2 Canalized aneurysm of the abdominal aorta and dilatation of the iliac arteries

all the pathological changes of the aorta and iliac arteries. This method consists in exposure of the femoral artery by blunt dissection under local anesthesia at the level of Scarpa's triangle and its puncture with a trocar 1.5 mm in diameter, through which are injected 50 cc of a 70 per cent solution of diodrast in two and a half to

opaque substance is injected by hand, the author has designed an apparatus that maintains a constant pressure and rate of injection. It consists of a pump with a piston which acts upon the plunger of the syringe. The piston is worked by an air compressor with a regulator and manometer. With a trocar 1.5 mm in diameter

<sup>1</sup> Read before the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept 24-29, 1944





Fig 7 Advanced atheroma of the aorta and iliac arteries with almost complete occlusion at the aortic cone  
 Fig 8 Roentgenogram of the anatomic specimen of the same case, showing the calcification and kinking of the arteries

with ulceration of the fourth toe. There were symptoms of intermittent claudication of approximately a year's duration.

Lately the pain had become intense, affecting both the foot and limb, increasing when the extremity was in the horizontal position. Physical examination revealed cyanosis of the toes. The skin was atrophic, with necrosis of the right big toe, including the interdigital space. This foot had a lower temperature than the other, with a non-palpable arterial pulse. There was marked sclerosis of the peripheral arteries. The arterial blood pressure was 130 maximum, 70 minimum, pulse 75. The oscilometer reading was 0 in all the limbs. Aortography showed marked reduction of the lumen of the external iliac and complete obstruction of the internal iliac arteries. Collateral circulation was greatly increased, forming an internal (epigastric and internal mammary) and an external arc (circumflex iliac and lumbar arteries). Figure 5 shows this collateral circulation, which is believed to be the first such observation in the living. There was thrombosis with complete obstruction of the terminal aorta and iliac arteries. A film made ten minutes after the injection revealed a normal urogram, showing that circulation above the obstruction was unimpaired.

P. P., 54 years old, was hospitalized because of

intermittent claudication of ten years duration. Physical examination revealed palpable epigastric pulsation. Palpation of the abdominal aorta and iliac arteries was painful. There was a very faint pulsation of the femoral arteries, especially of the left, with complete absence of pulsation at the left popliteal and posterior tibial arteries. The oscilometer did not record any pulsation in either of the lower extremities. The toes of the left foot became pale when the limb was raised for a few minutes and cyanotic when it was lowered. The blood pressure was 110 maximum, 70 minimum, pulse rate 72. A clinical diagnosis of arteriosclerosis with thrombo-arteritis at the bifurcation of the aorta and iliac arteries was made. Aortography showed an advanced degree of endarteritis obliterans involving all the right iliac arteries and considerably reducing their caliber, with marked collateral circulation (Fig 6).

In advanced cases, dilatation, elongation, and lime deposits give rise to a characteristic picture. By aortography the author has observed valvular kinks that retard circulation considerably. He believes himself to be the first to demonstrate

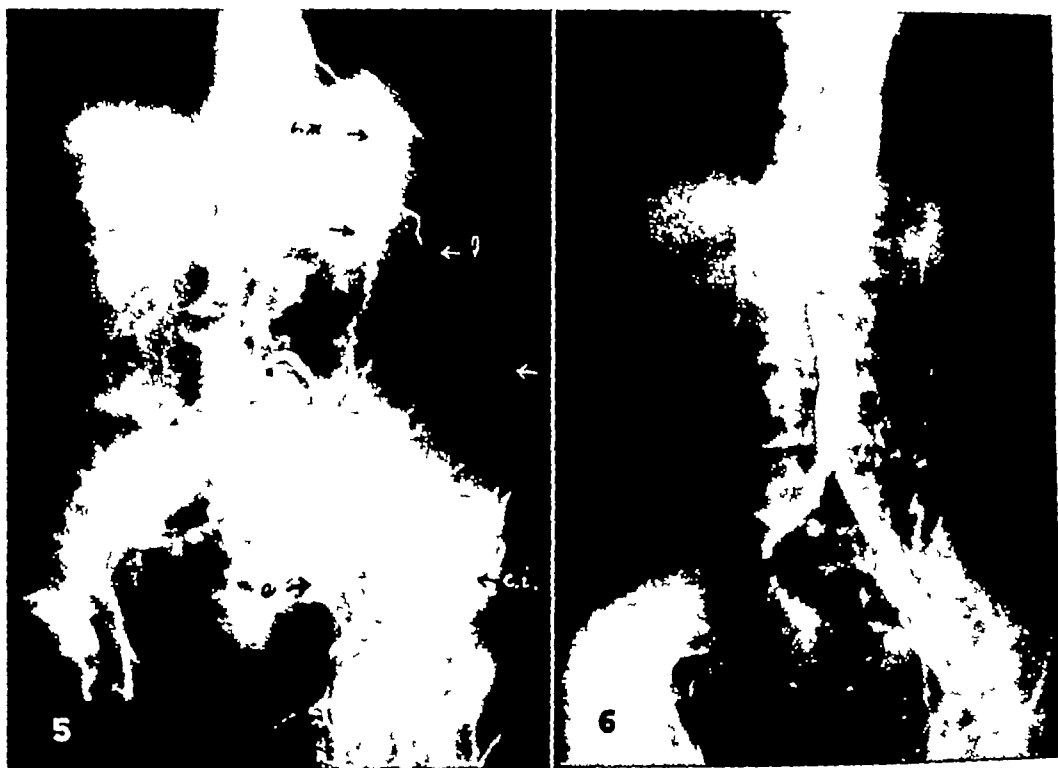


Fig 5 Reduction of the lumen of the external iliac and complete obstruction of the internal iliac. Greatly increased collateral circulation forming an internal arc (epigastric and internal mammary) and an external arc (circumflex iliac and lumbar arteries)

Fig 6 Endarteritis obliterans involving all right iliac arteries reducing their lumen. Marked collateral circulation

lumen. Thrombosis may cause complete obliteration. The muscular coat undergoes degeneration, leading to dilatation of the vessels. As an example, we have the following case:

R. G., 69 years old, white, with a clinical diagnosis of syphilitic aortic ectasia, gave a history of dyspepsia one year previous to hospitalization. The blood pressure was 205 maximum and 80 minimum, pulse rate 80 per second, oscillometric index, right thigh  $2\frac{1}{2}$ , left thigh  $2\frac{1}{2}$ . Abdominal palpation revealed an elongated, firm, pulsating aorta. On auscultation, a systolic murmur was heard. Aortography showed narrowing of the iliac arteries with a sacculated aneurysm at the end of the common iliac, as well as stenosis and dilatation of the abdominal aorta (Fig 3).

Degenerative lesions are more commonly found at the end of the abdominal aorta and iliac arteries. They originate in the intima and extend to the muscular and elastic coats. The lesions of the intima

produce thickening of the walls with narrowing of the lumen, those of the muscular and elastic coats produce atrophy. The vessel then loses its contractility and allows itself to become dilated by the blood pressure. Besides the dilatation, the artery becomes elongated and tortuous. The visceral branches of the aorta may become involved, impairing the circulation of the abdominal organs. The following case shows the aorta dilated, elongated, and tortuous (Fig 4).

A white woman had a large ovarian cyst. Radiologically, besides the ovarian cyst, we observed a parietal thrombosis of the terminal aorta, as shown by indentations of the arterial wall.

Thrombosis may completely obliterate the lumen of the vessel. As examples we have the following cases:

A. M., 74 years old, white, was hospitalized because of pain, cyanosis, and swelling of the right foot.

# Bilateral Osteochondritis Dissecans of the Knee<sup>1</sup>

CAPT R H HERMANSON, M C, A U S

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"OSTEOCHONDRITIS dissecans is an osseocartilaginous lesion of debatable etiology characterized by partial or complete demarcation of a segment of articular cartilage and subchondral bone with or without ultimate detachment and extrusion into the joint (16) "

## INCIDENCE

Osteochondritis dissecans occurs most frequently in young adults King (10) found the average age of onset to be eighteen years Males are affected four times as frequently as females Of the reported cases, 85 to 90 per cent involved the knee joint (2, 14, 16) In decreasing order of incidence, the hip, elbow, and ankle are also affected Hutchison (9) saw one case in the proximal phalanx of the right great toe and one in a metacarpal bone Among most clinical workers, however, the disease is considered to be primarily one of the knee joint (8)

In a series of 24 cases, King (10) found the condition to be bilateral in the knees in 20 per cent Bernstein (1) reported three cases involving both knees in members of the same family, one brother and two sisters King and Richards (11) found the disease to be bilateral in 30 to 35 per cent of a series of cases involving the hip Richards (15) and Dawson (4) each reported one case of bilateral osteochondritis dissecans of the knee, and others (8, 12, 14) state that both knees may be involved de Lormier (5) presented a case in which the lesion involved the patella of one knee and the medial femoral condyle of the opposite one

Among lesions producing internal derangement of the knee joint, osteochondritis dissecans is third in incidence (3) The commonest site is the lateral aspect of the medial femoral condyle Occasionally

the lateral condyle or the patella may be involved

## ETIOLOGY

The etiology of osteochondritis dissecans remains unknown and no entirely satisfactory explanation has yet been offered (14) The majority of authors favor a traumatic cause Both intra- and extra-articular trauma have been indicted Impairment of blood supply to the region affected, either as a result of damage to the blood vessels by the impaction of opposing articular surfaces or avirulent bacterial emboli lodging in epiphyseal arteries, has been considered as an etiologic factor Dawson (4) considers that the lesion may be due to congenital changes or have a developmental background Bernstein (1), Harbin and Zollinger (7), and Wagoner and Cohn (17) regard heredity as of importance Bernstein's cases of bilateral involvement of homologous joints in members of the same family are striking and lend important weight to this view It may well be that trauma is the inciting cause only in joint that are congenitally predisposed to the lesion It is significant that no inflammatory changes have been observed in the loose body

## PATHOLOGY

Conway (2) has described three stages in the pathology of osteochondritis dissecans In the first stage there is only a fairly well demarcated prominence of the articular surface The articular cartilage covering this elevation differs in color from the rest of the cartilaginous surface and the process can easily be removed at this stage It may also become permanently re-attached (1)

In the second stage the fragment has become more distinctly separated and lies within an excavated area of the articular surface It may be held in place by only

<sup>1</sup> Accepted for publication in November 1945

them radiologically in the living (Figs 7 and 8) Surgical removal of these valvular kinks was shown to benefit greatly the circulation of both extremities

#### CONCLUSION

The principal inflammatory and degenerative processes encountered by the author in the arteriographic study of the

abdominal aorta and iliac arteries are described above It is hoped that this procedure, which converts aortography into a simple arteriography, will contribute to a better knowledge of the pathological conditions of these vessels, thus offering new approaches to treatment

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may be slightly more difficult. Usually a tell-tale depression will remain in the femoral condyle and serve as a beacon for the alert observer.

Special roentgenographic technics are rarely necessary. In the great majority of cases, anteroposterior and lateral views will suffice accurately to delineate the process. Occasionally a postero-anterior projection with the knee in 45° flexion is indicated for better definition of the osteochondritic focus and to visualize the loose fragment within the joint. A very small loose body may sometimes be seen after the injection of air into the joint when other methods have failed to depict it.

#### DIFFERENTIAL DIAGNOSIS

Confusion with other disease processes seldom exists. Less frequent causes of loose body are synovial osteochondromatosis, trauma (13), and fracture of an osteophyte in osteo-arthritis. In osteochondromatosis the synovial membrane is involved, there are multiple loose bodies, and the underlying bone is intact. A history of preceding trauma and the location of the defect on the most exposed parts of the bones will serve to differentiate traumatic loose bodies. When fracture of an osteophyte occurs, other osteophytes usually are present at the articular margins of the tibia and femur, and the loose body usually has a greater density than the loose body of osteochondritis dissecans. Infectious arthritis, either specific or non-specific, may produce sequestration in the underlying bone. The location of the sequestra usually differs from that of osteochondritis dissecans and the regional bone is involved in the inflammatory process. Moreover, in acute infectious arthritis the joint space is increased because of fluid, and after the disease becomes chronic, the joint space is decreased because of the destruction of articular cartilage. The presence of a fabella should rarely cause confusion.

#### TREATMENT

A detailed discussion of therapy is beyond the scope of this paper. So far as the

knee is concerned, there is great unanimity of opinion that surgery is the treatment of choice. Cases without urgent symptoms and without elevation of the fragment may respond well to immobilization alone. Lieberman and Iseman (13) report such a case.

#### CASE REPORTS

Three cases of bilateral osteochondritis dissecans of the knee were recently observed at this station hospital within a period of three months and they are considered sufficiently interesting to merit presentation. During this interval, roentgen examination was performed on 92 knees. In this small series these were the only cases of osteochondritis dissecans observed. While the number is too small to permit of any conclusions, it does emphasize the fact that bilateral involvement is not uncommon. When the disease is found in one knee, routine roentgen examination of the supposedly normal knee should be performed. This procedure will uncover many unsuspected cases and may demonstrate that bilateral involvement is more common than it is at present thought to be.

**CASE I.** A 20-year-old soldier on active military duty for fourteen days reported to sick call, complaining of pain and stiffness in both knees of twelve years duration, occurring after walking or other exercise. There was no history of injury.

On physical examination both knees were found to be slightly enlarged with some limitation of flexion. There was slight tenderness along the anterior aspects of both medial femoral condyles. No instability was observed.

X-ray examination revealed a loose body about  $2.5 \times 3.5 \times 1$  cm. along the lateral aspect of each medial femoral condyle with a correspondingly large excavation of the condyle. The loose body in the right knee was fragmented.

**CASE II.** A 23-year-old soldier on active military duty for twenty-three months reported to sick call, complaining of inability to perform his duties. He stated that since the age of 13 he had suffered periodically from pain and weakness in the knees, that in civilian life his left knee not infrequently snapped and locked, and that it might take several days to regain full motion. During basic training he had trouble with the knee which necessitated reassignment to less strenuous duties. After a time, he was returned to training and began to experience diffi-

thin band of fibrous tissue or by a fairly firm adhesion. While it is attached, the fragment may be nourished by blood vessels in the pedicle and proliferation of a layer of fibrocartilage along the surface of separation may occur.

In the third stage, complete sequestration of the fragment into the joint cavity occurs. The detached fragment may remain free within the joint or become fixed to the synovial wall. When they are free in the joint, there is a pronounced tendency for the loose bodies to migrate into quiet areas, commonly the posterolateral pouch, the subquadriceps bursa, or the anterior compartment of the knee (10). After complete separation, all of the bony portion usually undergoes necrosis (14). The cells of the fibrocartilaginous covering are nourished by the synovial fluid. These cells slowly proliferate and the body increases in size. The growing fibrocartilage gradually absorbs and replaces the necrotic articular cartilage, and more slowly the necrotic bone, so that after a period of years the original constituents of the loose bony fragments may completely disappear. Concomitant calcification in the superficial layers of fibrocartilage produces a pathological type of new bone. Trauma to the articular surfaces produced by impaction of the loose body may result in extensive arthritic change. This usually results after the passage of a long period of time.

For obvious reasons, the changes in the osteochondritic bed have been less well studied. Wolbach and Allson (18) were able to study a case postmortem in a patient dying from another disease. They found a cyst in the cancellous bone beneath the fibrocartilage, to which they attributed etiologic significance in the formation of the loose body. The excavated area gradually becomes filled with fibrocartilage and the outline becomes shallower and less pronounced. In time, it may become exceedingly difficult to demonstrate.

#### CLINICAL PICTURE

Constant symptomatology is conspicuously absent in osteochondritis dissecans,

and a pathognomonic clinical picture is unknown. Acute symptoms occur after the fragment has been extruded from its bed, before this stage there may be no symptoms. According to King (10), patients may be divided into three groups. In the first group there is a sudden onset a few days subsequent to a twist or other injury. No history of previous disability is obtained. The joint is swollen and locked in 15 to 45° flexion. In the second group the condition is asymptomatic and is discovered on roentgen examination of a supposedly normal knee. Patients of the third group complain of a chronically troublesome knee with soreness, pain, and locking. Muscular atrophy is a late finding. It is significant that in King's series the history and clinical examination alone led to the diagnosis in only one case.

#### ROENTGEN FINDINGS

The diagnosis is readily established by roentgen examination. The osteochondritic focus appears as an arcuate area of diminished density in the medial femoral condyle. Before separation occurs, this may be only a faint shadow outlining a smooth, almond-shaped piece of bone which is of normal density and not appreciably elevated. As the disease progresses, the area of diminished density increases in size, due in great part to the proliferation of fibrocartilage both in the osteochondritic bed and around the separated fragment. Elevation and projection of the fragment beyond the surface of the surrounding normal bone then ensues. Fragmentation of the sequestrum is not unusual, especially with large sequestra. One sequestrum may divide into two or more fragments and present the appearance of cystic degeneration. With necrosis of the bony portion, the density of the fragment increases. The structure and density of the bone about the pathologic process remain normal throughout the course of the disease. In old, long-standing cases, however, arthritis may supervene, with resultant marginal osteophyte formation. After the loose fragment has migrated, recognition of the disease

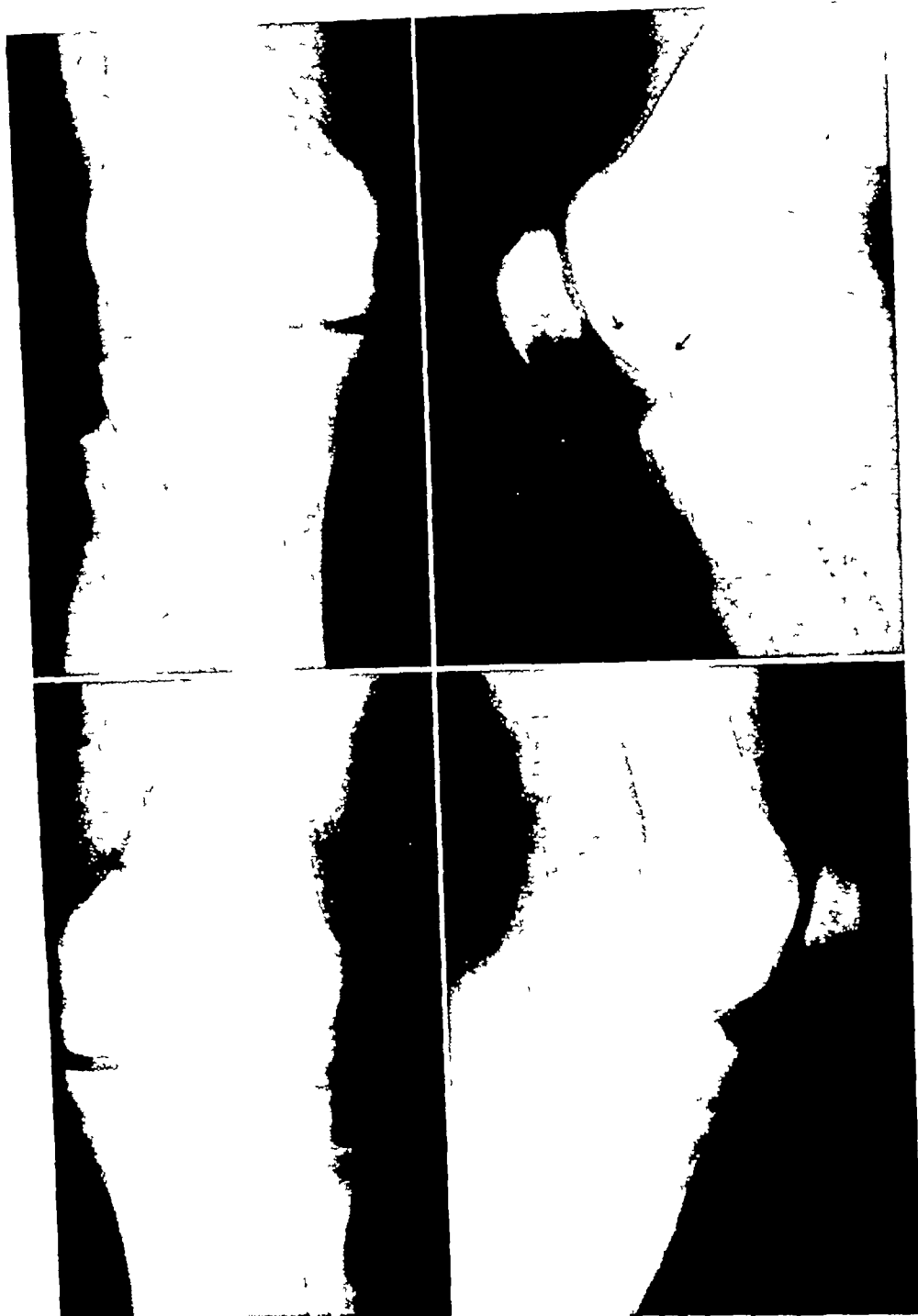


Fig 2 Case III The upper views are of the right knee and the lower ones of the left knee Note fragmentation of sequestrum in right knee

The process was more extensive in the left knee and the sequestrum was fragmented

CASE III A 19-year old private on active duty for two months reported to sick call, complaining of

pain in the knees for six years The pain was sharp and was aggravated by walking and by bad weather At night there was a mild ache and occasionally slight swelling of the knees Frequently a gritty sensation was felt in the knees There was no history of

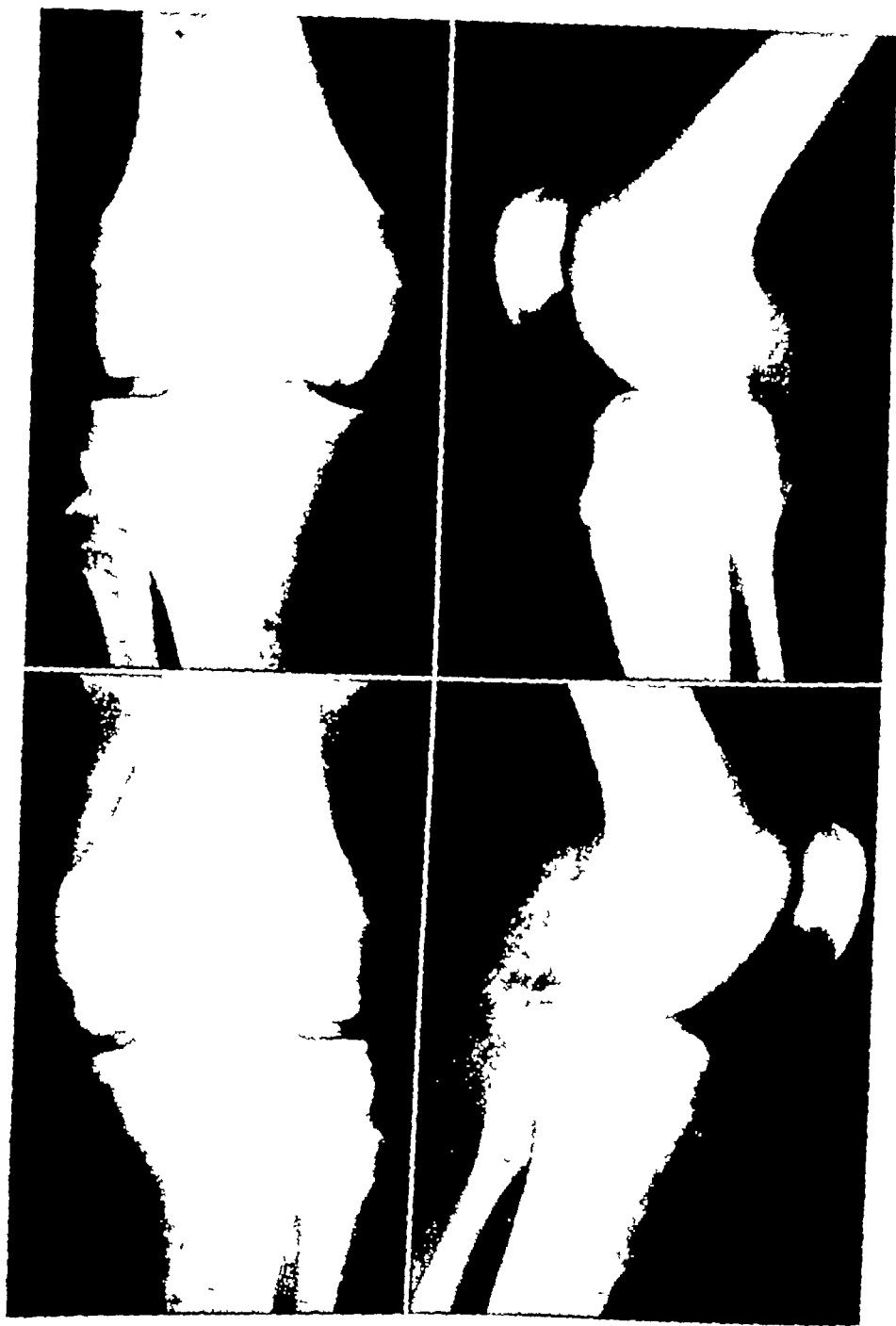


Fig 1 Case I Note the large size of the sequestra and fragmentation in the right knee which is shown in the upper views The lower views are of the left knee

culty with the right knee. This joint never locked, but an occasional clicking sensation was experienced. There was no history of trauma.

Physical examination revealed slight puffiness about both knees but no actual increase in joint fluid

There was a free range of motion, with slight lateral instability of both knees.

X ray examination revealed an irregular defect in the lateral aspect of each medial femoral condyle with a dense button of bone adjacent to the defect



# Heart Size from Routine Chest Films<sup>1</sup>

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ROENTGEN RAY determination of the size of the human heart may be extremely precise if one employs sufficiently refined technics, such as those for volume, or a mere approximation if the subjects have heart disease and the criterion of size is the transverse diameter of the frontal plane silhouette. Estimation of frontal plane area from orthodiagrams or from specially made films constitutes a practical compromise between these two extremes, and tables and equations have been developed for predicted normal area from height and weight.

The general radiologist faces daily the task of passing judgment on the shape and size of the hearts that he sees in routine chest films. In our laboratory such films invariably are stereoscopic and are accompanied by a record of the patient's height, weight, and anteroposterior chest diameter. Exposure times range from 1/30th of a second to 1/10th of a second, depending on the thickness of the chest, and there is no attempt to synchronize exposures with a particular point in the cardiac cycle. In spite of this, we find that there is seldom much difference in the size of the heart shadows in the two films. Occasionally one shadow will be distinctly smaller than the other, but in such cases rereading usually yields two shadows approximately alike and approximately the same as the larger shadow in the first pair.

These observations have led us to believe that the systolic size rarely is recorded on routine chest films and that the larger shadow in a pair of such films may be accepted as of approximately diastolic size.

When general inspection suggests cardiac enlargement or there is clinical reason to suspect it, we measure gross frontal plane area from the larger of the two shadows

in our chest films and then correct this value for divergent distortion. If the net frontal plane area thus obtained is within plus or minus 10 per cent of the normal area predicted by the patient's height and weight, we report it as normal but add in brackets the actual percentage variation from normal. When the variation exceeds 10 per cent, we report the heart as N per cent over- or undersize.

## TECHNICAL DETAILS

With a wax pencil the right and left borders are sketched in as solid lines and the arbitrarily drawn upper and lower limits as broken lines. These lines are now transferred to white tracing paper and, by means of a planimeter, the area enclosed within the solid and broken lines is measured—in other words, the gross frontal plane area of the heart. In our laboratory the outlining and tracing are done by the radiologist, the measurements by stenographers.

## CORRECTION FOR DIVERGENT DISTORTION

Because of the divergent distortion that is always present in ordinary roentgenograms, gross area is greater than true or net frontal plane area, the latter being obtained from the former by multiplying gross area by a correction factor  $F$ , obtained from the equation

$$F = \left[ 1 - \frac{K}{D} - \frac{C}{3D} \right]^2 \quad (1)$$

where  $F$  = divergent distortion correction factor,  $K$  = distance in cm between anterior surface of chest and film (in our apparatus, 25 cm),  $D$  = distance in cm between target of x-ray tube and surface of film (in our apparatus, 183 cm),  $C$  = anteroposterior diameter of chest in cm (varies

<sup>1</sup> Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov 9-10, 1945

trauma The patient's commanding officer noted that he appeared very willing but was unable to drill

The family history was interesting in that the patient's father had had "rheumatism" of the knees and hands for several years No x-ray studies had been performed, however, and it could not be determined if he also was suffering from osteochondritis dissecans

Physical examination revealed no evident abnormality Both knees were stable and had a full range of motion

X-ray examination showed a smooth button of bone at the lateral aspect of each medial femoral condyle with a corresponding arcuate defect in the condyle The loose body on the right extended for a considerable distance into the joint

All three patients were considered unfit for further military duty and were discharged from the Army

#### SUMMARY

1 Three cases of bilateral osteochondritis dissecans of the knee occurring in young adult males have been presented, and the incidence, etiology, pathology, and diagnosis have been discussed

2 Disability was sufficient in each case to require separation from the military service

3 Bilateral osteochondritis dissecans is not uncommon

4 The desirability of routine roentgen examination of the supposedly normal knee is emphasized, when osteochondritis dissecans is found in one knee This procedure may demonstrate that bilateral involvement is more common than is now suspected

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from approximately 5 cm to 28 cm depending upon the patient)

This equation assumes that the patient faces the film, and the final term  $C/3D$  depends upon Bardeen's demonstration that the frontal plane of the heart lies approximately one-third of the way back along the anteroposterior axis of the chest

If the patient stands back to film, the final term becomes  $2C/3D$ . Almost all of our measurements are done with the patient facing the film,  $D$  approximately 6 feet,  $K$ , the inherent distance between the film in the cassette changer and the bakelite sheet against which the patient stands, 3 cm. Sometimes, however, it is convenient to be able to attempt measurements under less satisfactory conditions (for example, with the patient standing back to film, in which case the final term becomes  $2C/3D$ ), and for various values of  $D$  and  $K$

Since the values of  $K$  and  $D$  will usually be fixed for a particular machine, it is a simple matter to reduce Equation 1 to a graph from which the factor  $F$  can be read as a function of anteroposterior chest diameter ( $C$ ), or factor  $F$  may be included as one of the columns in an alignment chart or nomogram

#### PREDICTION OF NORMAL AREA

For adults <sup>(1)</sup> the formula is

$$\text{Frontal plane area} = 0.87H + 0.34W - 63.8 \quad (2)$$

where  $H$  = subject's height in cm and  $W$  = weight in kg. For children <sup>(2)</sup> the formula is

$$\text{Frontal plane area} = 0.180H + 1.045W + 13.7 \quad (3)$$

#### NOMOGRAMS

The completion of the upper and lower borders of the silhouette requires some experience but takes only a few seconds of time, and the paper tracing is quickly and easily made. The computations would be far too tedious if they had to be done for each examination, but by reducing the various equations to alignment charts or nomograms (Figs 1 and 2) all computations are avoided. There remains the matter of measuring the area of the silhouette with a planimeter which, it must be ad-

mitted, is a rather exacting and time-consuming procedure

#### SUBSTITUTION OF PRODUCT OF LONG AND SHORT DIAMETERS FOR AREA OF THE SILHOUETTE

At a meeting of U S Public Health consultants at Bethesda, Md, in the fall of 1944, I reported work that Dr Gerhart Schwarz of our staff had been doing on heart measurements in 4 X 5-inch photo-roentgenograms as a precaution against the possibility that the wartime film shortage might force us temporarily to abandon the use of 14 X 17-inch chest films. In the discussion that followed, Dr Edward Chamberlain pointed out that certain combinations of diameters, such as the product of long and short diameters, unlike the transverse diameter, correlate closely with area, not only in the normal but also in the pathologically enlarged heart. Since planimeter measurements are particularly troublesome in the case of small films, he suggested that we might find it worth while to substitute for them the product of the long and short diameters. The long diameter of the silhouette is a straight line arising at the cardiovascular junction at the upper right aspect of the silhouette and extending to the apex of the heart at the lower left aspect. The short diameter is the sum of two segments:  $A$ , the perpendicular distance from the long diameter to the most distant portion of the right border, plus  $B$ , the perpendicular distance from the long diameter to the left border.

Following up this suggestion, Dr Schwarz has studied the publications to which Dr Chamberlain referred and has derived his own equation. He concludes that the best way to determine the size of the frontal plane area is to measure it with a planimeter, as we have been doing for years, but that without much sacrifice of accuracy one may simplify the technique by measuring the long and short diameters and multiplying their product by the factor 0.735.

In the case of miniature films, the area obtained will be that of the reduced size

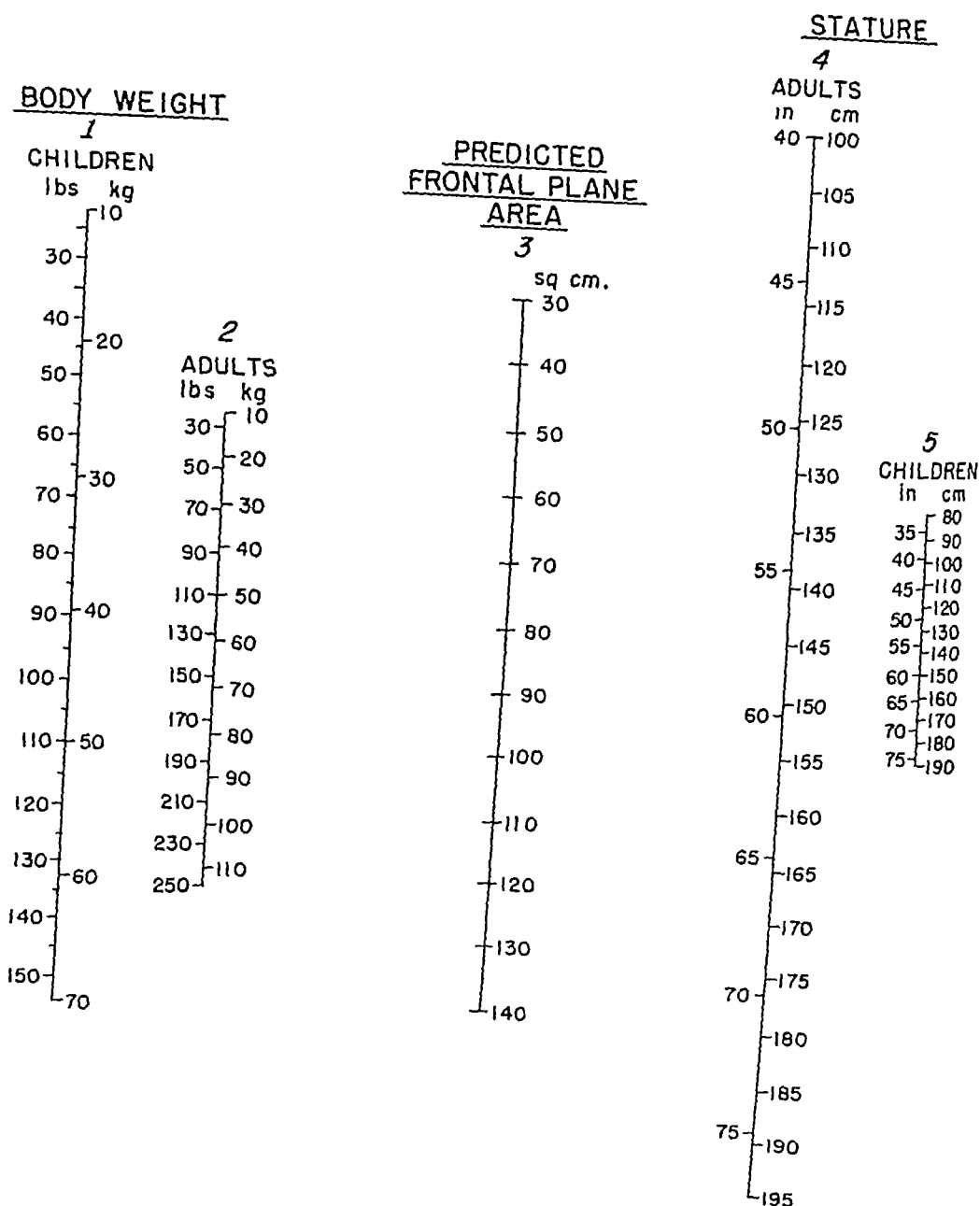


Fig 1 Nomogram for prediction of frontal plane area from height and weight according to Equations 2 and 3

1 For subjects 17 years old, use children scales (1 and 5) unless stature exceeds 170 cm, in which case use adult scales

2 Indicate weight and stature on respective scales. Lay a ruler on these points and at its intersection with Scale 3 read the predicted frontal plane area of the heart.

from approximately 5 cm to 28 cm depending upon the patient)

This equation assumes that the patient faces the film, and the final term  $C/3D$  depends upon Bardeen's demonstration that the frontal plane of the heart lies approximately one-third of the way back along the anteroposterior axis of the chest

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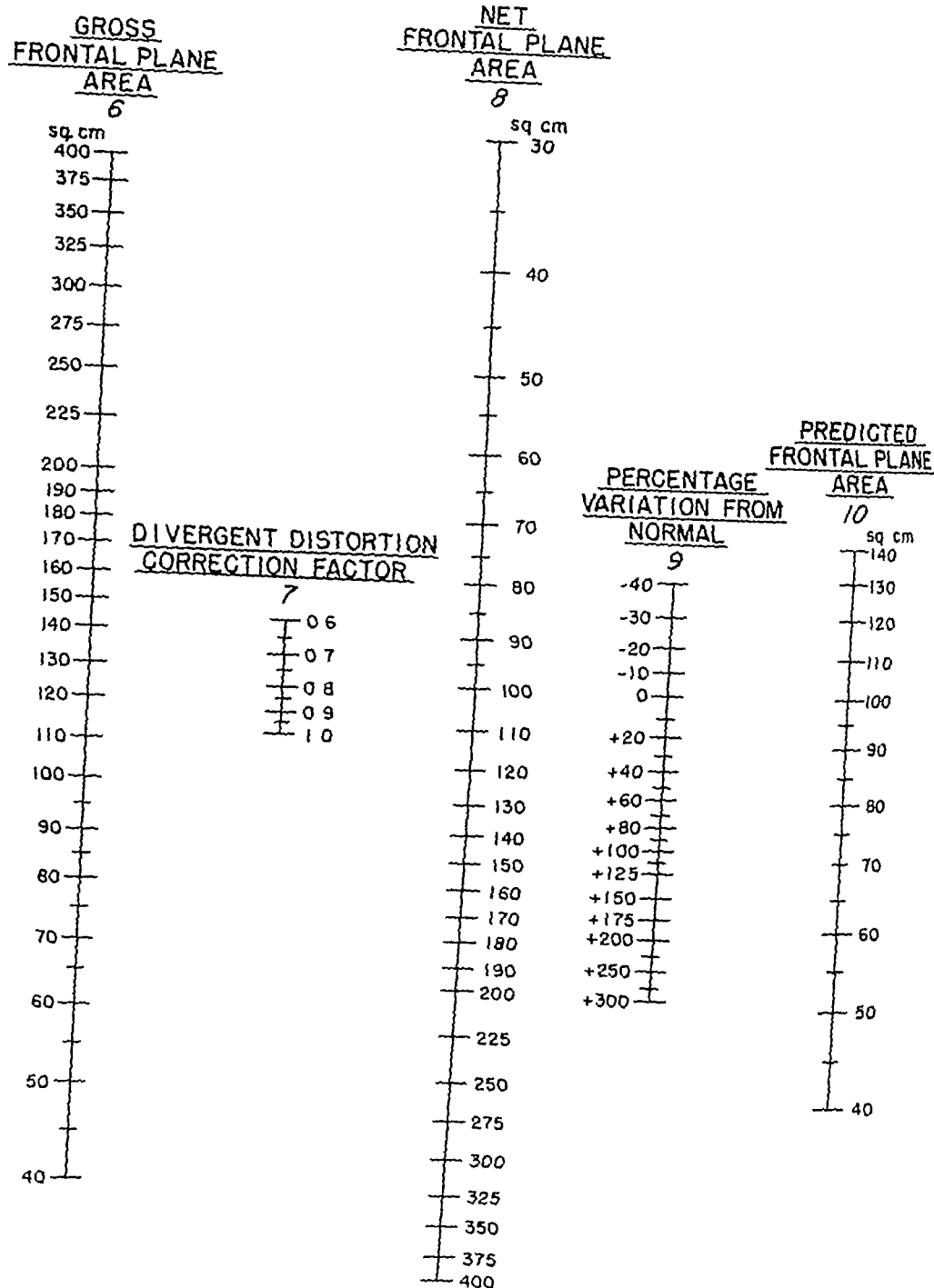


Fig 2 Nomogram for correcting for divergent distortion and estimating percentage variation of measured area from predicted area.

- 1 Indicate on Scale 10 the predicted frontal plane area obtained from Scale 3 of Fig 1
- 2 Measure the tracing of the silhouette with a planimeter and indicate the measured value on Scale 6
- 3 From appropriate graphs of Equation 1 and a knowledge of the AP diameter of the patient's chest, determine divergent distortion correction factor and indicate it on Scale 7
- 4 Lay a ruler on the indicated points on Scales 6 and 7 and at its intersection with Scale 8 indicate the net frontal plane area
- 5 Lay a ruler on the indicated points on Scales 8 and 10 and at its intersection with Scale 9 read and record the percentage by which the heart exceeds or is less than the normal predicted area for the subject being examined.

image, which in turn must be multiplied by the square of the linear magnification factor,  $M^2$ , in order to obtain gross frontal plane area. This in turn must be multiplied by the divergent distortion correction factor in order to obtain net frontal plane area. This procedure sounds complicated but, as a matter of fact, can be rendered simple by the construction of suitable alignment charts.

#### EVALUATION OF RESULTS

We expect to substitute Dr Schwarz's Equation 4<sup>(3)</sup> for planimetry in our heart measurements from 14×17-inch chest films, believing that the saving of time more than offsets the slight reduction in accuracy, and if the time were to come when stereoscopic 4×5-inch films were used by us as substitutes for 14×17's, rather than as a mere preliminary screen, we would employ Schwarz's Equation 6 with them. At present, however, like most others, we use 4×5-inch filming merely as a screen, and 35-mm and 70-mm filming probably always will be used exclusively for screening. If the cost of small film screening is to be held to a minimum, the films should be non-stereoscopic, a photo-

timer should make the exposure automatically, the accompanying record should be reduced to essentials, such as name and identifying number, and the subsequent reporting should amount to nothing more than a sorting into normals and non-normals, the latter to be returned for large film raying and eventual diagnosis. Clearly, quantitative heart measurement has no routine place in such a scheme, but perhaps Dr Schwarz's nomograms can be used as the basis from which to develop a coarse, rapidly applied criterion which, regardless of height, weight and anteroposterior chest diameter, will select those subjects whose hearts are so clearly enlarged as to merit return for large film study.

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# Determination of Frontal Plane Area from the Product of the Long and Short Diameters of the Cardiac Silhouette<sup>1</sup>

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THE PRECEDING article, by Dr Paul C Hodges<sup>(1)</sup>, describes the events leading up to the work to be reported here on the correlation between frontal plane area and the long and short diameters of the cardiac silhouette. For convenience two equations listed in that paper are reproduced

$$F = \left[ 1 - \frac{K}{D} - \frac{C}{3D} \right]^2 \quad (1)$$

where  $F$  = divergent distortion correction factor,  $K$  = distance in cm between anterior surface of chest and film (in our apparatus, 25 cm),  $D$  = distance in cm between target of x-ray tube and surface of film (in our apparatus, 183 cm),  $C$  = anteroposterior diameter of chest in cm (varies from approximately 5 cm to 28 cm, depending upon the patient)

$$A = 0.87H + 0.34W - 63.8 \quad (2)$$

where  $A$  = frontal plane area of heart in sq cm,  $H$  = subject's height in cm,  $W$  = subject's weight in kg

The material studied consists of 99 teleroentgenograms made on 93 subjects examined at the University of Chicago. Group 1 consists of 25 films of normal subjects (10 males, 15 females) of ages varying from 7 to 54 years, weight from 18 to 118 kg, height from 132 to 177.5 cm, and cardiac area from 72 to 145.5 sq cm. Group 2 consists of 74 films made on 68 subjects in whom clinical or x-ray evidence indicated heart disease. Thirty-five were males, 33 females, the ages varied from 6 to 82 years, weight from 14.1 to 88.9 kg, height from 100 to 185 cm, and cardiac area from 50 to 282 sq cm. Area ranged from 32 per cent undersize to 110 per cent

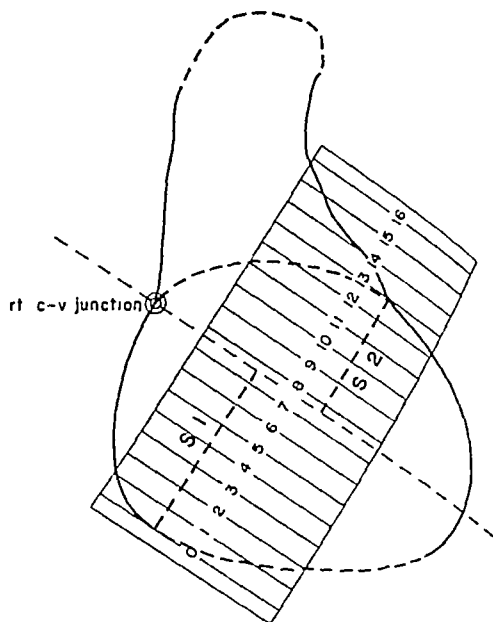


Fig 1 Tracing of teleroentgenogram showing frontal plane area, long and short diameters of silhouette and transparent ruler for measuring short diameter

The long diameter,  $L$ , extends from the cardio-vascular junction, upper right, to the cardiac apex, lower left. The short diameter,  $S$ , is most easily measured with the aid of a superimposed transparent ruler. With such a ruler aligned so that its lines are parallel with  $L$  and its zero line is tangent to the most prominent part on the lower border of the silhouette, one reads  $S$  as the most prominent point on the upper border of the silhouette. If such a special ruler is not available, it may be necessary to measure  $S_1$  and  $S_2$  separately and then add these values to obtain  $S$ .

oversize for build as computed by the Hodges and Eyster formula (Equation 2). In Group 2, three subjects were examined twice, one subject four times, during the course of cardiac disease.

The films were made with the subject standing or sitting facing a vertical cassette changer and with a target-film distance ( $D$ ) of approximately 6 feet. In most instances, filming was stereoscopic.

<sup>1</sup> Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill. Nov 9-10, 1945



and the tracing was made from the larger cardiac silhouette in the stereoscopic pair

#### WORK-UP OF FILMS AND TRACINGS

The silhouettes were outlined with wax pencil on the film and then transferred to semitransparent paper for planimetric measurement of area and linear measurement of the long and short diameters. This latter measurement may be done with an ordinary ruler but is made easier with the aid of a special rectangular transparent ruler (Fig 1). For each case the product of these diameters was divided into the area of the silhouette, the quotient being a factor which is indicated as  $F$  in Column 11 of Tables I and II.

#### TABULATION

Table I lists the values for the normals, Table II, for subjects with abnormal hearts. There are 13 columns in each table. Column 1 lists the x-ray number, 2, the sex, 3, the age, 4, the height in cm, 5, the weight in kg, and 6, the anteroposterior diameter of the chest in cm. Column 7 shows the frontal plane area in sq cm ( $A_m$ ) as measured by the planimeter, Column 8, the long diameter ( $L$ ) of the silhouette in cm, Column 9, the short diameter ( $S$ ) of the silhouette in cm. Column 10 lists the product of  $L$  and  $S$ , Column 11, the factor  $F$ , which is the quotient obtained by dividing the value in Column 7 by the value in Column 10. Column 12 lists the area ( $A_e$ ) obtained by computation from the formula for the ellipse ( $L \times S \times 0.785$ ), Column 13 lists area ( $A_{0.735}$ ) computed by the 0.735 formula presently to be described.

#### COMPUTATION

For the normals the mean value of  $F$  was 0.740, for the abnormals 0.730, the medial 0.735 was therefore chosen as the factor for general application. On this basis, the equation for the calculation of frontal plane area from long and short diameter becomes

$$A = L \times S \times 0.735 \quad (4)$$

where  $A$  = gross frontal plane area of the heart in sq cm in full-sized roentgenograms made with the patient facing the film at a target-film distance of approximately 72 inches,  $L$  = long diameter of cardiac silhouette in cm,  $S$  = short diameter of cardiac silhouette in cm.

From other material studied, it appears that the factor depends to a minor degree upon target-film distance ( $D$ ) and to a somewhat greater degree on the relationship of the chest to the film. When the patient is back to film, the factor becomes considerably smaller and when  $D$  is increased beyond 72 inches it becomes somewhat larger, being maximum for orthodiascopy where, of course,  $D$  may be considered as being infinitely great.

#### SIMILAR WORK BY OTHERS

Moritz<sup>(10)</sup> in 1931 divided the product of long and short diameters into frontal plane area as determined by orthodiascopy and obtained a factor of 0.763 when the patient was in the horizontal position and 0.752 when the patient was erect.

Ludwig<sup>(8)</sup> in 1939, also using orthodiasgrams and working on 120 normal Swiss soldiers, obtained a factor of 0.725. A number of workers<sup>(2, 5, 15)</sup>, including two insurance company examiners<sup>(13)</sup>, used the factor 0.785 on the assumption that the frontal plane area is an ellipse.

#### ACCURACY OF FORMULAE

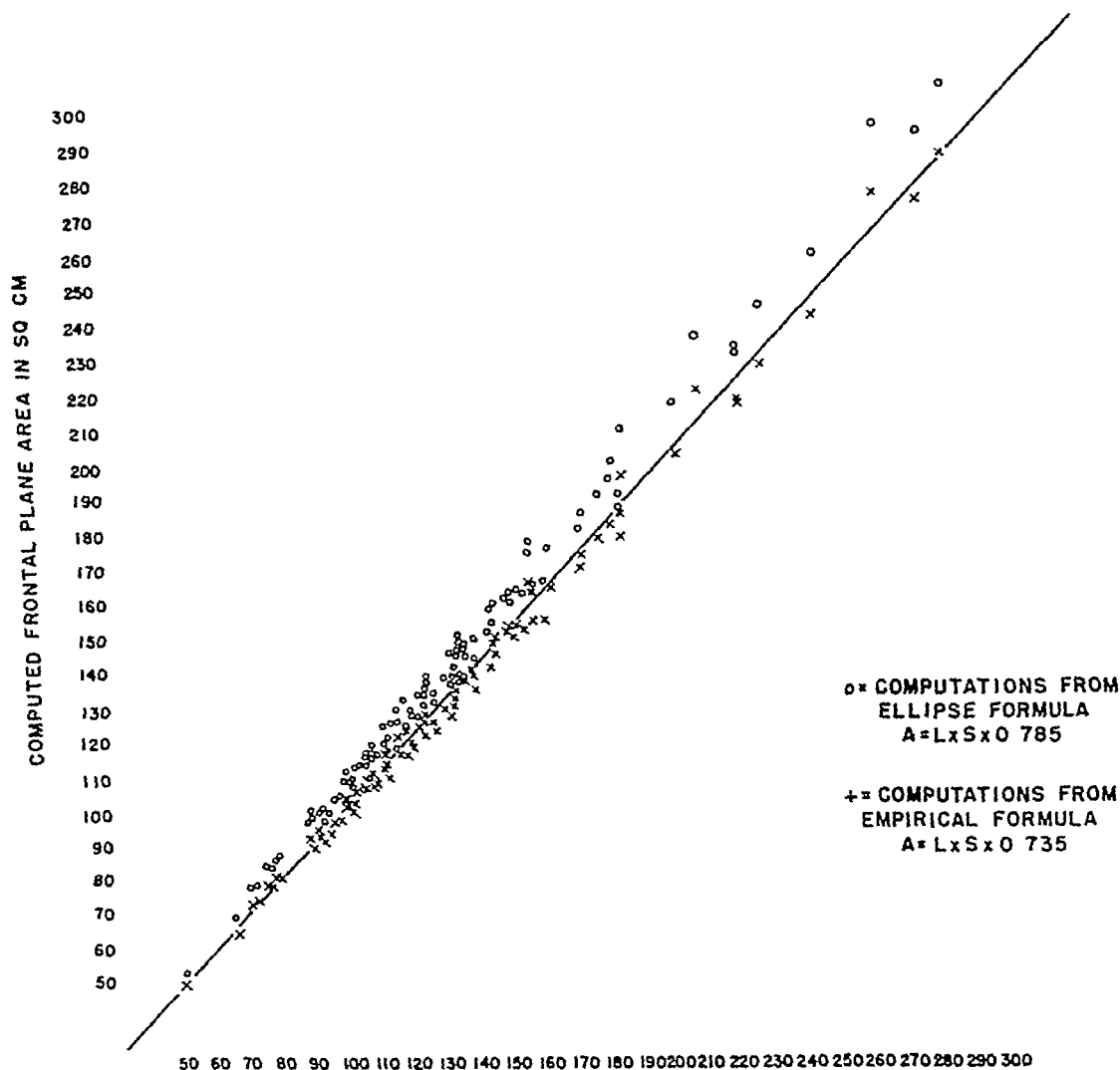
The material in Columns 12 and 13 of the two tables was collected to allow testing the relative validity of Equation 4 and the formula for the ellipse as predictors of frontal plane area. Inspection of Columns 7, 12, and 13 shows that in most instances the predictions by the ellipse formula are larger than the actual measured area, whereas the predictions by the 0.735 formula are sometimes a little larger, sometimes a little smaller, than the actual measured area. The difference is brought out graphically in Figure 2, where the predictions from the ellipse formula, plotted as circles, lie for the most part above the axis, whereas the predictions from the

TABLE I NORMAL HEARTS DATA FROM 25 FILMS ON 25 SUBJECTS

1	2	3	4	5	6	7	8	9	10	11	12	13
X-Ray No	Sex	Age	Height, cm	Weight, kg	AP Chest Diameter, cm	$A_m$	$L$	$S$	$L \times S$	$F$	$A_s$	$A_{0.735}$
117,018	F	35	151 0	118 0	27 0	102 0	13 3	10 1	134 33	0 7593	105 5	98 5
117,038	M	8	147 0	18 0	14 0	72 0	10 8	9 3	100 44	0 7103	78 1	74 0
117,037	M	27	177 0	73 0	21 0	136 5	15 5	11 9	184 45	0 7400	145 5	135 8
117,030	M	7	132 0	43 0	16 0	70 6	10 7	9 2	98 44	0 7171	77 0	72 0
117,028	F	26	147 0	47 6	16 5	88 2	12 1	10 1	122 31	0 7217	96 0	89 9
117,024	M	28	177 5	76 5	22 0	145 5	15 0	13 3	199 50	0 7293	156 0	146 5
117,041	F	31	167 0	64 3	20 5	100 0	13 3	10 5	139 65	0 7190	109 8	102 5
116,990	F	21	166 0	59 0	21 0	99 5	12 7	10 8	137 16	0 7354	107 8	100 7
116,991	F	34	157 5	58 2	21 0	111 5	13 9	10 8	150 12	0 7427	118 0	110 8
116,985	F	53	160 0	48 0	21 0	112 5	14 0	10 9	152 60	0 7372	120 0	112 5
116,981	F	35	169 5	68 4	21 5	111 5	14 1	11 1	156 51	0 7124	123 0	115 3
116,982	M	32	181 0	81 0	23 5	135 0	14 8	12 5	185 00	0 7297	145 0	136 2
116,980	F	24	164 0	130 0	20 5	108 3	13 5	10 9	147 15	0 7359	115 5	108 0
116,970	M	13	164 0	51 5	15 0	91 5	12 2	10 3	125 66	0 7282	98 7	89 2
116,975	M	21	178 0	46 0	19 0	124 5	14 0	12 2	170 80	0 7289	134 0	125 9
116,974	F	36	157 5	67 3	21 0	92 2	13 2	9 6	126 72	0 7275	99 5	93 0
117,005	M	20	174 0	63 6	21 0	105 5	13 6	10 7	145 52	0 7249	113 8	106 3
117,001*	M	7 5	136 0	29 4	14 0	78 0	11 4	9 5	108 30	0 7202	85 0	79 7
116,996	F	28	173 0	56 8	19 0	109 0	13 8	10 6	140 28	0 7451	115 0	107 2
116,997	F	27	155 0	49 5	18 0	96 0	12 7	10 3	130 81	0 7339	102 6	95 9
116,998	F	52	157 0	63 6	25 0	106 0	14 0	10 5	147 00	0 7210	115 5	107 7
116,989	F	17	157 0	59 0	19 0	92 0	12 3	10 2	125 40	0 7233	98 5	92 1
116,994	F	24	167 0	60 5	19 5	132 6	14 9	12 3	183 27	0 7235	143 5	134 8
116,995	F	22	160 0	66 0	20 0	115 3	13 8	11 8	162 84	0 7081	128 0	120 0
116,993	M	54	167 5	58 6	21 0	117 3	13 6	11 5	156 40	0 7500	122 5	115 0

\* Subject sitting rather than standing

 $A_m$  = Gross frontal plane area in sq cm, as measured by planimeter $A_s$  = Frontal plane area in sq cm calculated by ellipse formula $A_{0.735}$  = Frontal plane area in sq cm calculated by 0.735 formula $L$  = Long diameter of cardiac silhouette in cm $S$  = short diameter of cardiac silhouette in cm $F$  = factor obtained by dividing  $A_m$  by  $L \times S$



#### FRONTAL PLANE AREA IN SQ CM. MEASURED BY PLANIMETER

Fig 2 Relative accuracy of 0.735 formula and ellipse formula in computing frontal plane area.

Values computed from Equation 4 ( $A = L \times S \times 0.735$ ), indicated as +, are distributed evenly about the axis, while those computed from the ellipse formula ( $A = L \times S \times 0.785$ ), indicated as ○, tend to be too large

0.735 formula, represented as crosses, are arranged symmetrically on both sides of the line of regression. The distribution of errors has been tabulated as follows:

*Formula for the Ellipse* The deviation of calculated values from measured values was as follows:

The maximum deviation was +11.83 per cent or +31 sq cm. In only one instance was the deviation zero. A negative deviation did not occur.

*Formula  $L \times S \times 0.735$*  The deviation of calculated values from measured values was as follows:

	Cases		Cases
1% or less	1	±1% or less	30
More than +1% to 2%, inclusive	2	More than ±1% to ±2%, inclusive	32
More than +2% to 3%, inclusive	4	More than ±2% to ±3%, inclusive	15
More than +3% to 4%, inclusive	9	More than ±3% to ±4%, inclusive	11
More than +4% to 5%, inclusive	13	More than ±4% to ±5%, inclusive	9
More than +5% to 12%, inclusive	70	More than ±5% to ±6.5%, inclusive	2

TABLE II ABNORMAL HEARTS DATA FROM 74 FILMS ON 68 SUBJECTS

1 X-Ray No	2 Sex	3 Age	4 Height, cm	5 Weight, kg	6 AP Chest Diameter, cm	7 $A_m$	8 $L$	9 $S$	10 $L \times S$	11 $F$	12 $A_c$	13 $A_{0.716}$
119,229	M	39	172 6	79 7	25 5	244 0	20 80	15 00	324 48	75 20	255 0	238 0
111,293	M	31	171 0	07 0	20 5	134 0	15 80	11 00	183 28	73 11	144 0	135 0
117,088	F	61	167 0	52 0	20 0	137 0	15 20	12 00	182 40	75 10	143 0	134 0
122,019	F	44	151 3	54 4	18 0	106 0	13 00	11 00	143 00	74 13	112 0	105 0
122,245	M	18	174 1	61 0	20 5	125 0	14 50	12 00	174 00	71 83	136 5	128 0
122,115	M	20	170 0	79 6	21 0	155 0	16 10	12 70	204 47	75 80	160 5	150 5
122,395	M	53	159 0	50 0	22 0	203 0	20 60	18 00	370 80	70 05	291 0	272 0
122,028	M	64	175 5	64 0	22 0	228 0	19 40	15 80	306 52	74 38	241 0	225 0
121,931	F	37	157 0	58 4	19 5	109 0	13 40	11 10	148 74	73 28	117 0	109 0
94,761	M	5	114 0	19 6	13 0	65 5	10 80	8 10	87 48	74 87	68 7	64 5
38,440*	M	11	145 6	34 9	16 5	75 0	11 70	9 10	106 47	70 44	83 5	78 0
38,440*	M	12	153 9	30 8	17 5	94 5	12 10	10 40	125 84	75 10	98 8	93 0
38,440*	M	12	153 9	30 8	17 5	77 0	11 60	9 10	105 50	72 04	83 0	77 5
73,621*	F	17	173 2	62 3	16 5	103 0	13 70	10 35	141 80	72 64	111 2	104 0
73,621*	F	19	154 0	47 0	20 0	127 5	14 60	11 30	104 98	77 20	129 5	121 5
73,621*	F	19	155 0	42 9	18 5	101 0	13 05	10 50	137 03	73 71	107 5	100 5
77,774*	F	37	162 8	06 2	20 5	139 5	15 05	12 45	186 75	74 43	147 0	138 0
77,774*	F	65	162 0	03 2	19 5	127 3	14 20	11 90	168 98	75 33	132 8	124 5
77,774*	F	66	162 0	03 2	19 5	136 5	14 70	12 70	186 09	73 12	146 5	137 5
77,040	F	30	170 0	57 2	19 0	185 0	18 55	12 05	240 22	77 01	188 5	176 5
70,727	M	56	175 5	78 0	19 0	157 3	16 25	13 50	219 38	71 70	172 0	151 5
79,003	M	19	170 0	63 9	19 5	135 0	14 80	12 05	187 22	72 11	147 0	137 5
122,795	M	53	171 0	68 1	21 5	139 0	16 15	11 10	183 15	75 89	148 3	139 0
122,015	F	43	173 0	76 6	22 5	127 0	14 25	11 90	169 58	74 89	133 3	124 5
78,993	M	63	177 0	91 8	27 5	185 0	18 50	12 70	234 95	78 74	185 0	173 0
78,559	M	55	163 0	61 2	22 0	153 0	15 50	13 30	206 15	74 22	162 0	151 5
70,594	M	64	172 7	87 4	24 0	144 0	15 00	12 70	190 50	75 59	150 0	140 0
79,565	M	75	162 2	64 9	24 0	158 0	17 50	11 90	208 25	75 87	163 5	153 0
79,652	F	42	150 0	70 0	25 5	132 0	15 20	11 30	171 76	76 85	135 0	126 5
82,214	F	11	145 0	31 0	16 0	92 8	12 40	9 00	122 70	75 59	96 5	90 0
80,892	M	64	174 2	62 8	22 0	161 5	16 80	12 40	208 32	77 52	164 0	153 0
52,651*	F	20	162 8	62 4	19 0	120 5	13 70	11 70	160 29	75 18	126 0	117 5
52,651*	F	23	162 8	64 3	19 0	124 5	14 30	11 80	168 74	73 78	132 5	124 0
78,490	F	59	154 3	60 0	20 0	133 5	15 10	11 80	178 18	74 92	131 0	131 0
78,542	M	28	171 7	60 8	19 0	163 2	16 50	13 40	221 10	73 81	173 5	162 5
78,042	F	9	137 0	28 3	15 0	104 0	13 10	10 90	142 79	72 83	112 2	105 0
77,930	F	22	159 8	51 2	17 5	116 0	13 70	11 00	158 03	72 60	124 5	110 5
77,898	F	55	166 5	74 0	22 5	130 0	14 30	12 20	174 40	74 52	137 0	128 0
80,785	F	48	185 0	79 0	21 0	172 5	17 60	13 00	228 80	75 30	170 5	168 0
80,095	M	61	170 0	88 0	25 5	173 5	17 80	11 10	233 14	71 11	183 0	171 5

80,449	I	62	167.5	56.6	19.5	133.0	14.50	12.10	175.45	75.81	137.5	129.0
70,986	I	82	156.0	55.0	18.0	124.0	14.90	11.00	163.90	75.66	128.5	120.5
70,711	M	59	164.6	79.7	26.0	146.0	15.60	12.90	201.24	72.55	137.0	128.5
70,656	I	19	150.0	59.1	20.0	130.5	14.20	12.30	174.66	74.72	108.5	101.5
123,933	I	21	159.6	53.2	18.0	102.0	13.30	10.40	138.32	73.74		
21,016	M	75	167.5	65.0	18.5	122.5	14.70	11.45	108.32	72.78	132.0	122.5
70,479	F	53	147.5	51.8	22.0	145.5	16.05	12.10	194.21	74.92	152.5	143.0
80,625	M	39	171.4	54.4	18.5	108.0	13.60	11.00	149.60	72.19	117.5	109.5
78,027	M	26	178.5	53.4	21.0	98.0	13.05	10.10	131.81	74.35	108.5	96.5
77,682	M	58	174.2	66.0	22.0	114.0	13.90	11.35	157.77	72.26	124.0	116.0
77,587	F	21	175.3	62.9	18.5	79.0	11.50	9.50	109.25	72.31	86.6	80.0
83,027	F	24	172.1	70.0	20.5	140.0	15.25	11.90	181.48	77.14	142.5	133.5
82,864	F	26	160.0	68.6	20.0	135.0	15.30	12.40	189.72	71.16	149.0	139.5
88,718	F	47	153.0	46.5	21.0	157.0	16.60	13.40	222.44	70.68	175.0	163.5
88,146	F	28	153.1	69.1	24.5	125.0	14.85	11.80	175.23	71.33	137.5	129.0
88,143	M	58	175.0	49.3	21.5	188.0	19.20	13.75	264.00	70.45	207.0	194.0
87,690	F	23	153.1	54.5	20.5	113.0	13.70	10.80	147.96	76.37	116.2	108.5
86,058	F	39	160.5	56.3	21.5	118.5	14.50	10.80	156.60	75.67	123.0	115.0
85,638	F	25	144.0	68.0	29.0	133.5	14.80	12.20	181.78	73.44	143.0	133.5
82,629	F	46	162.2	54.0	19.0	108.0	13.30	10.90	144.97	74.50	114.0	106.5
69,227	M	27	180.0	81.8	21.5	151.0	15.80	13.00	205.40	73.52	161.0	151.0
98,523	M	44	185.0	94.1	24.0	150.0	15.70	13.00	204.10	73.49	160.0	150.0
53,777	F	21	188.1	53.6	18.0	118.0	14.10	11.80	168.38	70.92	130.5	122.0
124,758	F	6	100.0	16.4	13.0	50.0	9.40	7.10	66.74	74.92	52.4	49.3
122,442	M	30	163.0	55.4	19.0	151.0	16.70	12.10	202.07	74.73	158.5	149.0
121,450†	M	70	166.0	70.8	23.0	221.0	20.00	14.60	292.00	75.68	229.5	214.5
116,956	M	57	186.0	75.4	27.0	275.0	21.40	17.20	368.08	74.71	289.0	270.5
118,601	M	48	177.7	86.2	26.0	282.0	22.00	17.50	385.00	73.25	302.0	283.0
110,288	F	60	150.0	70.0	24.0	182.0	18.90	13.00	245.70	74.07	193.0	180.0
117,334	M	6	110.0	14.1	12.0	89.0	12.60	9.80	123.48	72.08	97.0	90.5
120,189	M	64	172.5	71.5	22.0	221.0	20.50	14.20	291.10	75.91	228.5	214.0
120,433	M	30	166.0	62.0	21.0	202.0	19.20	14.20	272.64	74.09	214.0	200.0
122,709	M	47	171.0	90.5	27.5	209.0	19.40	14.90	289.06	72.30	233.0	218.0
120,386	F	23	162.0	56.9	19.5	178.5	17.90	13.40	239.88	74.42	188.5	176.0

$A_{0.735}$  = Frontal plane area in sq cm calculated by 0.735 formula

$L$  = Long diameter of cardiac silhouette in cm

$S$  = Short diameter of cardiac silhouette in cm

$F$  = Factor obtained by dividing  $A_{0.735}$  by  $L \times S$

\* Films taken at intervals during course of disease

† Subject sitting rather than standing

$A_{0.735}$  = Gross frontal plane area in sq cm as measured by planimeter

$A_c$  = Frontal plane area in sq cm calculated by ellipse formula

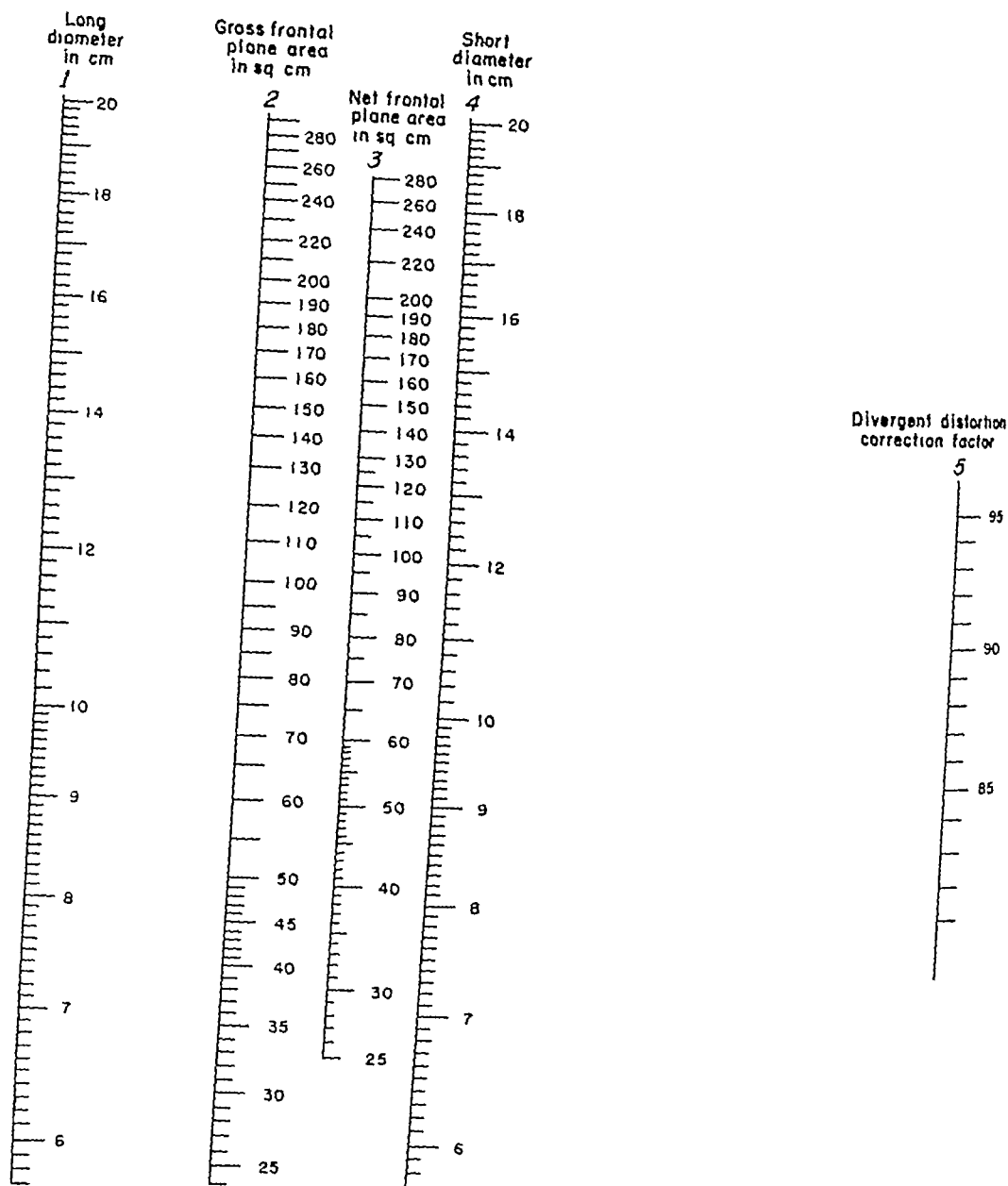


Fig 3 Nomogram for computing net frontal plane area from long and short diameters of cardiac silhouette in full-sized teleroentgenograms

- 1 Measure long and short diameters and indicate these values on Scales 1 and 4
- 2 Place a ruler on the indicated points on Scales 1 and 4 and indicate on Scale 2 the gross frontal plane area and indicate its value on Scale 5
- 3 By means of a graph or alignment chart of Equation 1, determine divergent distortion correction factor
- 4 Place a ruler on the indicated points on Scales 2 and 5 and read on Scale 3 the net frontal plane area of the cardiac silhouette.

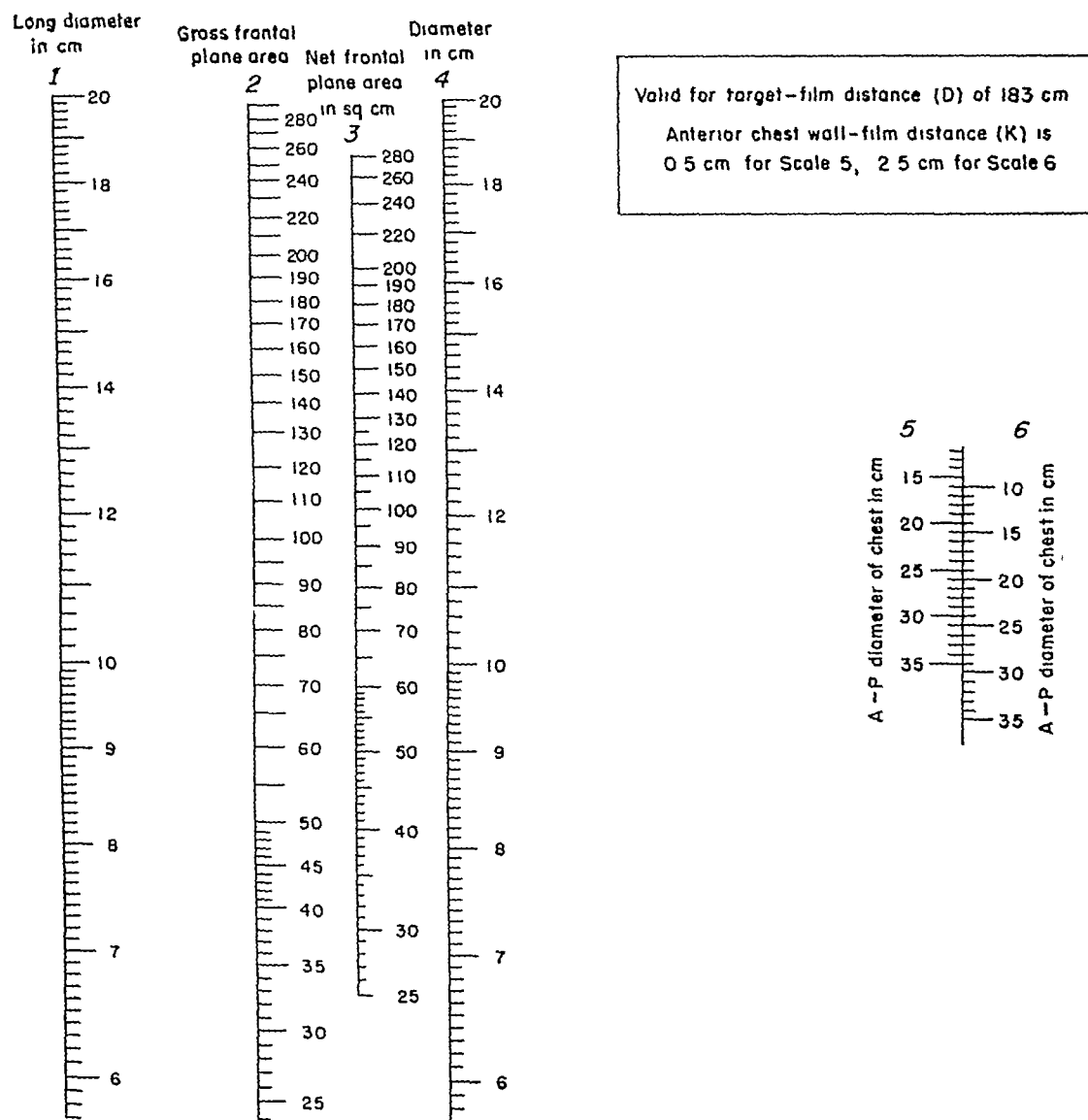


Fig. 4 Same as Fig. 3 but with addition of alignment chart for divergent distortion

- 1 Measure long and short diameters and indicate these values on Scales 1 and 4
- 2 Place a ruler on the indicated points on Scales 1 and 4 and indicate on Scale 2 the gross frontal plane area.
- 3 Measure patient's AP chest diameter in cm and indicate this value on Scale 5 if the chest is in direct contact with the cassette or on Scale 6 if the film is in the stereoscopic changer
- 4 Place a ruler on the indicated points on Scale 2 and on Scale 5 or 6 and then read on Scale 3 the net frontal plane area

*Note* While the chart is designed for a  $D$  of 183 cm and a  $K$  of 0.5 cm (Scale 5) or 2.5 cm (Scale 6), the prediction will be only 3 per cent too large if  $D$  is as short as 5 feet, and minor variations in  $K$  do not introduce serious errors

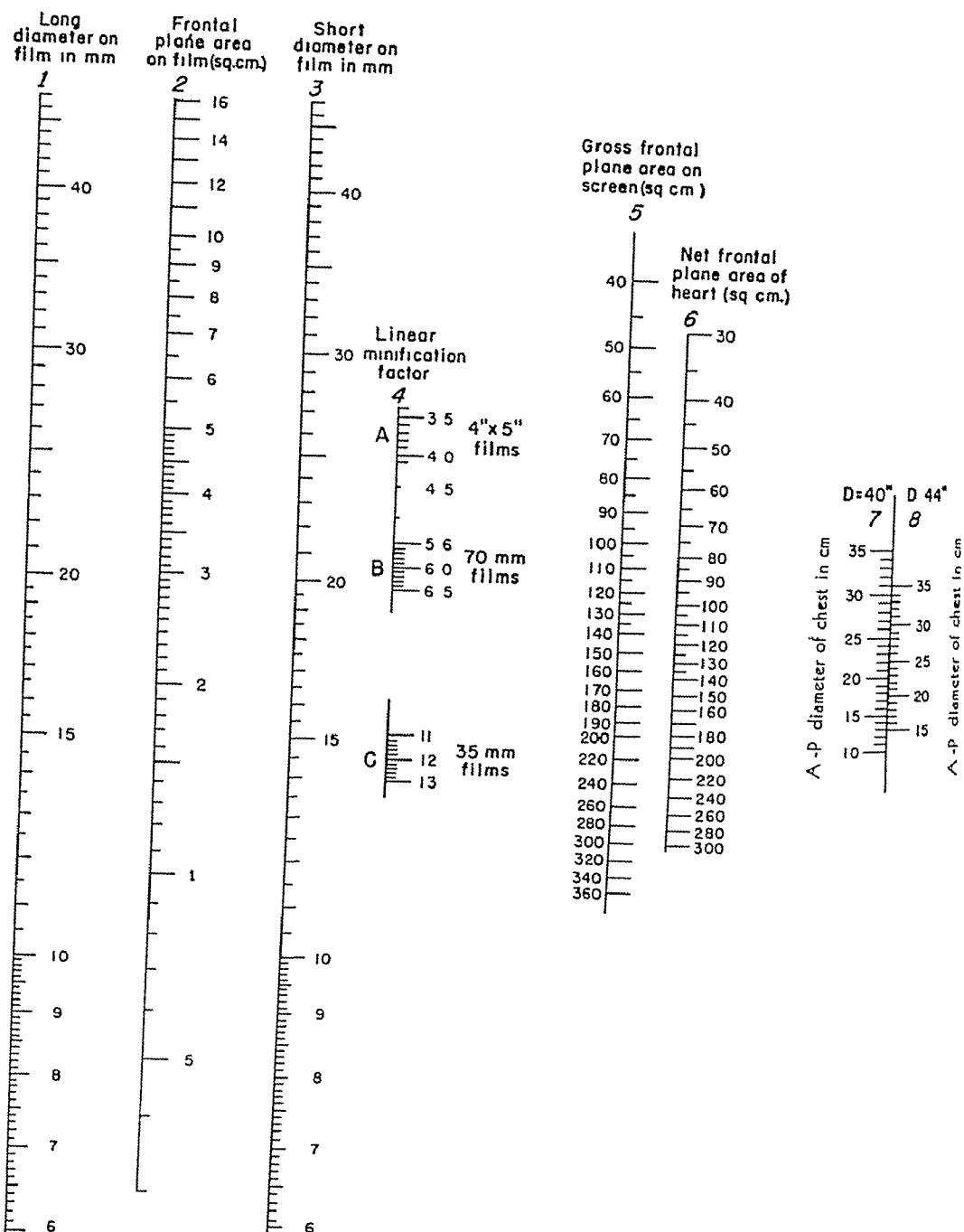


Fig 5 Nomogram for computing net frontal plane area of cardiac silhouette from measurement of long and short diameters in miniature films

- 1 Indicate on the appropriate portion of Scale 4 the linear minification factor of the machine being used
- 2 Indicate on Scales 1 and 3 the measured values of the long and short diameters of the miniature silhouette
- 3 Place a ruler on the indicated points on Scales 1 and 3 and at the intersection of Scale 2 record the area of the miniature silhouette
- 4 Place a ruler on the indicated points on Scales 2 and 4 and at the intersection with Scale 5 indicate gross frontal plane area of the heart (full size)
- 5 Measure patient's AP chest diameter in cm and indicate value on Scale 7 if D is 40 inches, or on Scale 8 if D is 44 inches
- 6 Place a ruler on the indicated points on Scale 5 and on Scale 7 or 8 and at the intersection with Scale 6 indicate the net frontal plane area of the heart.
- 7 From Fig 2 of Hodges' paper (page 358) obtain percentage variation from normal



The maximum deviation was  $\pm 7$  per cent and  $-6.5$  per cent, the minimum deviation zero. This indicates that the formula  $L \times S \times 0.735$  is more accurate than the ellipse formula.

The accuracy of both formulae has also been compared by statistical methods. The results in abbreviated form are as follows:

*Formula for the ellipse* Mean difference between calculated and measured area  $+0.49$  per cent with a standard deviation of  $2.55$ . Coefficient of correlation  $0.9918$ .

*Formula  $L \times S \times 0.735$*  Mean difference between measured and calculated area  $-0.15$  per cent with a standard deviation of  $2.39$ . Coefficient of correlation  $0.9958$ .

The means of both formulae were compared in order to see whether the discrepancy between them might be caused merely by scattering of values. This was done by comparing the difference between the means of the two formulae with the standard error of this difference. If this difference is greater than 3 times its standard error, it can be said to be statistically significant, since the law of probability indicates that with such a difference there are 99.7 chances out of 100 that the difference is not due to chance. In this case the difference between the means of the formulae is  $6.35 \pm 0.3495$ , which shows clearly that it is significant, since it is 18 times greater than its standard error.

#### MINIATURE FILMS

Tracings of miniature films are made directly on highly transparent paper by means of a sharp-pointed hard lead pencil. The factor of linear minification,  $M$ , is obtained from

$$M = \frac{I}{i} \quad (5)$$

where  $I$  = length in cm of an image on the fluorescent screen and  $i$  = length in cm of the corresponding microfilm image.

The linear minification factor for a particular apparatus may be measured as follows:

A strip of lead pierced with two small

holes spaced 10 cm apart is attached to the front surface of the hood. Target-screen distance ( $D$ ) and object-screen distance ( $d$ ) are measured. In the image ( $I$ ) that will be developed on the fluorescent screen, the distance between the holes will be  $10 \text{ cm} \times (D/D-d)$ . Now a microfilm is made and  $i$  is measured on the film. By substituting in Equation 5 the computed value of  $I$  and the measured value of  $i$ , the linear minification factor is obtained.

In the case of miniature films, the equation for computing gross frontal plane area,  $A$ , becomes

$$A = L \times S \times 0.735 \times M^2 \quad (6)$$

where  $M$  is the factor of linear minification.

#### NOMOGRAMS

Three nomograms are provided to facilitate application of the various formulae, and the bibliography lists several texts that explain the construction of alignment charts.

#### SUMMARY

1. In the working up of teleroentgenograms, it is possible to avoid use of the planimeter and compute frontal plane area from measurement of the long and the short diameters of the cardiac silhouette.

2. The equation for this computation is

$$A = L \times S \times 0.735$$

where  $A$  = gross frontal plane area in sq cm,  $L$  = gross long diameter in cm,  $S$  = gross short diameter in cm. It is based on measurement of abnormal as well as normal hearts, and correlation between computed area and planigraphically measured area is high ( $r = 0.9958$ ).

3. The frontal plane silhouette is only approximately elliptical, and the standard equation for the ellipse ( $A = L \times S \times 0.785$ ) yields areas that almost always are too large.

4. Nomograms provided in this and the preceding paper (Hodges) yield net frontal plane area and also the amount by which this value varies from normal.

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# Esophagopleural Fistula Complicating Empyema<sup>1</sup>

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**E**SOPHAGOPLEURAL fistula secondary to purulent empyema thoracis is an uncommon condition. Seventeen cases from the literature are reviewed here, in most of which the diagnosis was made when particles of ingested food appeared in material from the draining empyema cavity. The case to be recorded is the first in which the diagnosis of esophagopleural fistula was established by roentgen examination prior to any operative procedure.

## REPORT OF CASE<sup>2</sup>

A 4-year-old white girl was admitted to Alton Memorial Hospital, Oct. 10, 1944, because of diarrhea and vomiting of one week duration. She had been chronically ill during the past two years, but all treatment had been at home until the present admission. Two years earlier she had had an acute illness and the parents were told she had pneumonia followed by a lung abscess. She apparently recovered in about three weeks but since that time she had had an intermittent chronic cough and frequent colds.

One year preceding admission, depression of the right chest was noticed, and this had become progressively more pronounced. The parents thought that during the three months prior to the present illness the child's health had been better than at any other time in the past two years. During the past year, however, there had been a marked loss of weight and strength. One week before admission there was sudden vomiting of watery, greenish yellow material. Diarrhea and fever followed, and the patient became acutely ill. There was frequent cough, which often stimulated vomiting.

**General Examination.** The patient was obviously ill. She was emaciated and extremely poorly developed. Her weight was only 19 pounds, and the body appeared to be that of a 2-year old child. The right chest was flattened at the apex, there was pronounced scoliosis, and the anteroposterior diameter was greatly decreased on the right. There was no respiratory excursion. On the right, breath sounds were diminished, on the left, a few sticky rales were heard. The liver was palpable. The fingers showed early clubbing.



Fig. 1 Admission roentgenogram, showing incomplete development of the right thorax and an opacity over most of the right lung field, with a fluid level and air in the midportion. (The trachea is well visualized and is shifted to the involved side, and should not be confused with free air in the pleural cavity.) Opaque material in the colon and in the lower portion of the right lung field is presumably a medicament, and suggests a communication between the gastro-intestinal tract and the right pleural cavity.

Temperature on admission was 103°. The urine showed 3+ albumin and an occasional hyaline cast. There were 23,800 leukocytes, with 83 per cent neutrophils and 17 per cent lymphocytes. The erythrocyte count was 4,400,000, with 62 per cent hemoglobin.

There was repeated vomiting of foul smelling green fluid. At the Alton Memorial Hospital the patient was given supportive treatment only.

**Roentgen Examination.** A postero-anterior view of the chest (Fig. 1), made the day after admission, revealed a complete opacity over most of the right

<sup>1</sup> From the Department of Radiology, Alton Memorial Hospital, Alton, Ill. Accepted for publication in October 1945.

<sup>2</sup> Patient admitted on the pediatrics service of Dr. Noble D. McCormack.



Fig 2 Esophagogram revealing two clearly defined fistulae from the esophagus to the right pleural cavity

side, with a fluid level in the mid-portion and air above the fluid. Pronounced lack of development of the right thorax indicated long duration of the condition.

Traces of opaque material seen in the colon were assumed to be some opaque medicament. A faint trace of a substance of similar density was seen in the lower portion of the right chest. This formed a denser shadow within the opacity and apparently was within the pleural effusion. This observation immediately started speculation as to how the opaque material arrived in the pleural cavity. On the assumption that it was similar to that observed in the colon and was actually in the pleural space, the existence of a fistula from the gastro-intestinal tract to the pleural cavity seemed most probable. The history of sudden vomiting of probably purulent material was suggestive of rupture of an empyema into the esophagus.

Fluoroscopic observation of a barium swallow was done, and two fistulae from the esophagus into the empyema cavity were readily visualized. A roentgenogram clearly demonstrated these fistulae at the level of the fifth and seventh dorsal vertebrae (Fig 2).

*Treatment and Course* The patient was referred to the St. Louis Children's Hospital for treatment. On Oct. 21, 1944, Dr. J. Karl Poppe, of the Barnes

Hospital surgical chest service, resected segments from the right seventh and eighth ribs. A thoracotomy tube was inserted, draining a very large posterior chronic empyema cavity, containing foul, dark-colored pus, food, and barium. The patient coughed up some of the same material immediately after the incision was made.

On the first postoperative day there was profuse drainage of old barium, pus, and gentian violet, which had been given by mouth. A gastric tube was inserted, through which eight daily feedings were administered. Transfusions and other supportive treatment were given.

On the third postoperative day the patient vomited a tube feeding and some of it appeared on the dressing.

On Nov. 15, 1944, the gastric tube was removed. The patient was given gentian violet by mouth, none of which appeared on the dressing. It was concluded that the fistulae had closed, and subsequently there had been no recurrence.

About two months after operation, ambulatory and afebrile, but with a thoracotomy drainage tube in the right chest, the patient was transferred to Ridge Farm, the St. Louis Children's Hospital convalescent home, where she gained weight and progressed satisfactorily.

In April 1945 she was discharged, completely afebrile and ambulatory, with her thoracotomy entirely closed and no evidence of any residual empyema cavity on roentgen examination. She was last seen in November 1945, thirteen months after the original examination. At that time she was in excellent health, she weighed 35 pounds, and roentgen examination revealed aeration of the involved lung. A barium swallow showed irregularities at the sites of the fistulae but no interference with deglutition.

#### DISCUSSION

Perforations of the esophagus are not uncommon, and may be due to trauma, including that incident to foreign bodies and instrumentation, to carcinoma, simple ulceration, strong chemicals, rupture of a diverticulum, or spontaneous rupture during severe vomiting. Perforation is usually followed by mediastinitis or empyema, or both. There often result shock, severe sub-sternal pain, dyspnea and cyanosis, death may occur within twenty-four to forty-eight hours. Should the patient survive esophagopleural fistula with secondary empyema may occur.

Esophagopleural fistula secondary to pre-existing empyema is unusual. Blauvelt (5), Torbett and Bennett (17), Kanter

and Madoff (12), and Cohen and Sindell (8) have reviewed the literature within the past ten years. All have included cases due to tuberculous empyema, whereas this review excludes the obviously tuberculous cases. Berman and Walters (4) reported a case of empyema complicated by broncho-esophagopleural fistula, they were unable to find any earlier report of such a fistula, either as a cause or result of empyema.

Data from 17 cases from the literature, and the one here reported, are summarized in Table I. The ages ranged from 2 to 52 years, but only 3 patients were over 17. The cases were approximately equally divided between the sexes, and there was no definite predilection for either side.

*Etiology* In this group of cases the fistula was preceded by a purulent empyema. In parts of its course, the esophagus lies in direct contact with the mediastinal pleura. It seems most probable that the empyema creates an inflammation of the esophageal wall, with ulceration, or necrosis, and perforation. The actual rupture of the weakened esophageal wall might occur during the act of swallowing or vomiting.

In some cases, such as the one here reported, the empyema was obviously neglected, but in others there had been prompt and adequate surgical treatment. In McCormick's (13) case a rubber tube was found in the empyema cavity when it was reopened three years after the previous operation.

In 2 of the 7 cases which came to autopsy the fistula communicated with an esophageal diverticulum. It is obvious that a diverticulum, or some other inherent weakness of the esophagus, might be an unproved predisposing factor in any of these cases.

Cohen and Sindell reported 7 cases associated with tuberculous empyema. Tuberculous empyemas are notoriously chronic and there were no cures in these 7 cases. Eleven of the 18 non-tuberculous cases were cured.

*Diagnosis* has depended chiefly upon

observation of particles of food in the drainage from the empyema cavity. Roentgen confirmation has been obtained in some instances.

If the patient is under close observation, the signs and symptoms may be diagnostic. Ballin and Saltzstein (3) recorded a change in physical signs from those of hydrothorax to those of hydropneumothorax. In the presence of hydrothorax, dysphagia may be a premonitory sign. At the time of rupture there is often vomiting of pus, with relief of the dysphagia. This is usually followed by an elevation of temperature and an increase in toxicity as the pleural space is secondarily invaded.

If a thoracostomy or aspiration is done, the presence of food particles in the drainage is diagnostic of communication between the gastro-intestinal tract and the pleural space. If the drainage has the foul sour odor of butyric acid or fermentation, or there is a variegated bacterial flora or yeast cells, such a communication is probable.

The site of the communication can be further localized by instilling an indicator dye, such as gentian violet, into the stomach with a stomach tube. If this dye does not appear in the drainage, it is assumed that the fistula is from the esophagus, if it does appear, such a possibility is not excluded, as the dye might have been regurgitated. Existence of a fistula is confirmed if, after oral administration, the dye appears on the dressing.

The diagnosis can be confirmed by roentgen examination. Such examination is necessary to determine the exact location of the fistula and is the only conclusive diagnostic procedure in the absence of a thoracostomy opening or aspiration.

*Treatment* of the empyema is the same as in the uncomplicated case, adequate drainage of the empyema cavity usually requires rib resection.

Treatment of the fistula has been chiefly conservative. By tube feeding or gastrostomy the esophagus is put at rest, and the fistula closes spontaneously. Arquellada (2), in 1920, was the first to report

TABLE I REPORTED CASES OF ESOPHAGOPLEURAL FISTULA COMPLICATING EMPYEMA

Author and Year Reported	Age	Sex	Side	Bacteriology	Duration of Empyema Prior to Fistula	Diagnosis of Fistula	Treatment	Duration of Fistula	Result	Autopsy
1 Samuelson 1894	11	M	R	Pneumococcus	5 years	Food in drainage 1 month after thoracotomy	Thoracotomy		Died	Ulcer of esophagus emptied into pleural space
2 Thursfield 1902	4 1/4	M	R		5 1/2 months	Food in drainage 4 days after second rib resection	Two rib resections	2 weeks	Died	Fistula due to erosion by empyema
3 Bullough 1911	16 mo	F	L			Food in drainage first postoperative day, patient had vomited for 1 week	Rib resection		Died	Fistula 3 inches above diaphragm, no diverticulum
4 Arquellada 1920	9	M	L	Streptococcus, staphylococcus	2 months	Food in drainage 2 months after rib resection	Rib resection, Levine tube	3 weeks	Cured	
5 Crawford 1921	17	M	R		1 year +	Food in drainage 1 year after rib resection, roentgen confirmation	Rib resection, gastrotomy		Died 3 days after gastrotomy	Diverticulum communicated with pleural cavity
6 Ballin and Saltzman 1922	15	M	R	Pneumococcus, B. butyricus, yeasts	1 month maximum	Dysphagia relieved by vomiting pus, physical signs changed from those of hydrothorax to those of hydropneumothorax, food in drainage 4 days postoperative, roentgen confirmation	Rib resection, Rehfuss tube for 3 weeks	8 months	Cured	
7 Fonte 1922	52	M	L	Possibly syphilitic	Months	Food in drainage	Resection, irrigation	Months	Cured	
8 Hand and Lee 1922	2	M	L	Pneumococcus	5 days	Food in drainage 4 days postoperative roentgen confirmation	Thoracotomy, tube feeding, then solid food only	6 days (roentgen confirmation of closure at 3 weeks)	Cured	
9 Vos 1923	8	M	L	Pneumococcus, variegated form	3 weeks	Food in drainage	Rib resection stomach tube	3 weeks	Cured	



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3 Bullough 1911	10 mo	F	L			Food in drainage first postoperative day, patient had vomited for 1 week	Rib resection		Died	Fistula 3 inches above diaphragm, no diverticulum
4 Arquellada 1920	9	M	L	Streptococcus, staphylococcus	2 months	Food in drainage 2 months after rib resection	Rib resection, Levine tube	3 weeks	Cured	
5 Crawford 1921	17	M	R		1 year +	Food in drainage 1 year after rib resection, roentgen confirmation	Rib resection, gastrotomy		Died 3 days after gastrotomy	Diverticulum communicated with pleural cavity
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# The Use of Pyridoxine Hydrochloride in Radiation Sickness<sup>1</sup>

H L VAN HALTERN, M.D

Pontiac, Mich

FOLLOWING THE publication of Maxfield's results in the treatment of radiation sickness by pyridoxine hydrochloride (vitamin B<sub>6</sub>) in 1943 (6), we became interested in this drug and subsequently began its use in radiation sickness at The Henry Ford Hospital. In order to give the drug a thorough trial, it was decided to limit its use to the more severe cases and not to use it prophylactically. With this in view, we arbitrarily classified our cases of radiation sickness into four groups: (1) mild (anorexia and some nausea), (2) moderate (rather severe nausea, distaste for food, and occasional vomiting), (3) severe (pronounced nausea and frequent vomiting), (4) late or inflammatory symptoms due to proctitis, enteritis, and cystitis.

No medication was offered to patients falling in the first group. Those in the other three groups received intravenous injections of 25 to 50 mg of pyridoxine hydrochloride, in the form of Hexabetalin, beginning with the onset of symptoms. No other medication was given to any patient either prophylactically or otherwise unless specifically indicated. The injections were made at intervals varying from one to four days according to therapeutic response.

The results were arbitrarily classified as (1) excellent, *i.e.*, complete relief of all symptoms, (2) good, *i.e.*, relief of all vomiting and most of the nausea, (3) poor, *i.e.*, no appreciable abatement of symptoms.

Since inauguration of the use of pyridoxine hydrochloride, 81 patients have received this drug. The age and sex of the patients, the diagnosis, daily total x-ray dosage, and results of medication are given in the accompanying tabulation. Fractional doses to skin tolerance were used in

most cases, and the total daily dosage represents the total roentgens, measured in air, given to all fields treated.

From the accompanying table it is seen that, among the total of 81 cases, excellent results were obtained in 44 (54 per cent), and good results in 28 (35 per cent). In 9 cases (11 per cent) vomiting was not entirely relieved and a troublesome degree of nausea remained. Some of the last group had a noticeable relief of symptoms, and others none at all, in general, there was no relief of diarrhea, tenesmus, and urinary frequency, but in many cases nausea and vomiting were diminished. Tincture of opium in a suitable vehicle gave the greatest relief to the Group 4 cases.

Recent literature has added to the possible physiological causes of radiation sickness. Bean, Spies, and Vilter (1) gave x-ray therapy to patients who had a definite vitamin deficiency and who were suffering from various stages of pellagra or peripheral neuritis. They found a known, although rough, correlation between the severity of radiation sickness and the degree of vitamin deficiency. They were also able to show that correction of the vitamin deficiency prior to x-ray therapy was much more efficient in obviating radiation sickness than administration of vitamin B after irradiation was begun. They suggest that the basic disorder in radiation sickness is a disturbance in respiratory enzyme systems.

Jenkinson and Brown (5) have likened the findings to those of shock. They have graphically illustrated the effect of x-rays on the capillary beds, with resultant anoxemia of cells, local capillary dilatation, and finally, loss of plasma into the tissues. They also point out that radiation sickness is most likely to follow irradiation of those

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tube feeding, and his was the first reported cure

Blauvelt suggested the possibility of surgically closing the fistula, but such an attempt had not been reported until Berman and Walters successfully cured the first reported broncho-esophagopleural fistula in this manner. Conservative treatment having proved unsuccessful after seven months, they did a two-stage operation, including further rib resection and complete decortication of the empyema cavity. The broncho-esophagopleural fistula was easily identified, the esophagus was dissected loose from the bronchus, and the fistula was closed with interrupted catgut. The bronchus was dealt with in a similar manner.

#### SUMMARY

1 A case of esophagopleural fistula as a complication of empyema, diagnosed by roentgen examination prior to any operative procedure, is reported.

2 A brief review of similar cases in the literature is given.

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Case	Age	Sex	Diagnosis	Daily Dose of Radiation	Result of Treatment with Pyridoxine Hydrochloride
60	41	Female	Carcinoma of breast	300 r	Excellent
61	44	Female	Carcinoma of cervix and vagina	400 r	Excellent
62	52	Female	Carcinoma of ovary	400 r	Excellent
63	42	Female	Carcinoma of rectum	675 r	Excellent
64	39	Female	Carcinoma of cervix with extension to broad ligaments	400 r	Excellent
65	26	Male	Carcinoma of nasopharynx with metastasis to spine and pelvis	700 r	Good
66	45	Male	Carcinoma of rectum	400 r	Excellent
67	25	Male	Marie-Strümpell arthritis	400 r	Excellent
68	34	Female	Marie-Strümpell arthritis	450 r	Excellent
69	42	Female	Carcinoma of cervix with local metastasis	400 r	Good
70	33	Female	Carcinoma of cervix	400 r	Excellent
71	34	Female	Carcinoma of cervix with metastasis	650 r	Excellent
72	11	Female	Actinomycosis of lungs and pleura	150 r	Excellent
73	33	Female	Metastatic carcinoma of spine and abdomen	675 r	Good
74	61	Male	Carcinoma of bladder	400 r	Poor
75	64	Female	Carcinoma of breast with metastasis	650 r	Good
76	24	Female	Hodgkin's disease	600 r	Excellent
77	43	Female	Lymphoblastoma	600 r	Excellent
78	64	Female	Metastatic carcinoma of spine and pelvis	650 r	Poor
79	49	Female	Carcinoma of ovary, inoperable	650 r	Excellent
80	36	Female	Carcinoma of cervix	600 r	Excellent
81	50	Female	Carcinoma of kidney	300 r	Excellent

parts of the body possessing the largest capillary beds and, to combat it, they recommend administration of a vasoconstrictor such as benzedrine sulfate. The results obtained with this and a like drug were encouraging.

More recently, Ellinger (3) has called attention to the close correlation between the threshold dose of x-rays producing liver injury in the laboratory animal and sensitivity to histamine. He points out the close similarity of liver damage due to x-rays and that produced by injections of histamine, the histologic appearance of the liver cells being identical. An increase in bile secretion was also observed both after irradiation and histamine administration. Ellinger believes that he has proved experimentally that histamine is liberated in the tissues irradiated by x-ray and that it is to this histamine effect on the capillaries and liver that radiation sickness is attributable. If this theory is correct, it may well be possible to prove a direct relationship between histamine sensitivity in man and the unexplained occurrence of

severe radiation sickness. We feel there is need for further experimentation in order to determine the mode of action of pyridoxine hydrochloride in the relief of radiation sickness.

### CONCLUSIONS

Our experience in the use of pyridoxine hydrochloride in radiation sickness leads us to believe that it is a reliable and harmless method of relieving that condition.

**ACKNOWLEDGMENT** We are indebted to Eli Lilly & Company for supplying much of the Hexabetaol used in this work.

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TABLE I CASES OF RADIATION SICKNESS TREATED BY PYRIDOXINE HYDROCHLORIDE

Case	Age	Sex	Diagnosis	Daily Dose of Radiation	Result of Treatment with Pyridoxine Hydrochloride
1	61	Female	Carcinoma of esophagus	300 r	Excellent
2	37	Female	Sarcoma of chest wall	300 r	Excellent
3	53	Female	Carcinoma of ovary	400 r	Good
4	24	Female	Lymphoblastoma	350 r	Good
5	61	Male	Carcinoma of rectum	400 r	Good
6	61	Male	Carcinoma of bladder	400 r	Poor
7	38	Female	Marie-Strümpell arthritis	400 r	Good
8	58	Female	Carcinoma of ovary	400 r	Good
9	63	Female	Carcinoma of rectum with metastases	600 r	Excellent
10	32	Female	Hodgkin's disease	600 r	Good
11	46	Female	Carcinoma of cervix	400 r	Good
12	45	Female	Carcinoma of rectum	650 r	Excellent
13	47	Female	Carcinoma of cecum	700 r	Good
14	28	Male	Marie-Strümpell arthritis	400 r	Excellent
15	48	Female	Carcinoma of cervix	600 r	Excellent
16	48	Male	Seminoma of testis	400 r	Excellent
17	45	Female	Carcinoma of bladder	300 r	Good
18	57	Male	Metastatic carcinoma of lungs	700 r	Excellent
19	57	Female	Carcinoma of uterus with metastasis	375 r	Excellent
20	40	Female	Carcinoma of bladder	400 r	Excellent
21	43	Female	Carcinoma of esophagus	300 r	Good
22	71	Female	Carcinoma of uterus	400 r	Excellent
23	45	Male	Carcinoma of prostate with metastases in spine and pelvis	675 r	Good
24	45	Female	Carcinoma of breast with generalized metastases	600 r	Poor
25	20	Male	Sarcoma metastatic to spine and lungs	600 r	Poor
26	40	Male	Marie-Strümpell arthritis	400 r	Poor
27	28	Female	Carcinoma of ovary	400 r	Good
28	56	Male	Carcinoma of rectum	400 r	Good
29	54	Female	Carcinoma of cervix	400 r	Excellent
30	40	Female	Carcinoma of cervix	400 r	Good
31	42	Female	Carcinoma of kidney	300 r	Excellent
32	33	Male	Marie-Strümpell arthritis	400 r	Poor
33	44	Female	Carcinoma of uterus	400 r	Good
34	23	Female	Endometriosis with abdominal metastasis	600 r	Good
35	40	Female	Carcinoma of cervix	400 r	Good
36	34	Female	Hodgkin's disease	350 r	Excellent
37	33	Male	Marie-Strümpell arthritis	400 r	Excellent
38	73	Male	Regional ileitis	150 r	Good
39	47	Female	Carcinoma of bladder	300 r	Excellent
40	44	Male	Seminoma of testis	400 r	Excellent
41	70	Female	Carcinoma of kidney	300 r	Excellent
42	48	Male	Hodgkin's disease	300 r	Excellent
43	14	Male	Grawitz tumor of kidney with metastasis	600 r	Good
44	77	Female	Carcinoma of ovary with abdominal metastasis	350 r	Good
45	73	Female	Carcinoma of breast	300 r	Excellent
46	58	Male	Carcinoma of rectum with metastases	400 r	Good
47	25	Male	Marie-Strümpell arthritis	400 r	Excellent
48	37	Male	Marie-Strümpell arthritis	400 r	Good
49	52	Female	Carcinoma of cervix with metastasis to pelvis	600 r	Excellent
50	27	Male	Marie-Strümpell arthritis	400 r	Good
51	12	Female	Virus pneumonia	150 r	Excellent
52	68	Female	Lymphosarcoma, retroperitoneal	200 r	Good
53	56	Male	Carcinoma of tonsil with metastasis to cervical nodes	200 r	Poor
			Rheumatoid arthritis	400 r	Poor
54	63	Male	Marie-Strümpell arthritis	400 r	Excellent
55	32	Male	Carcinoma of ovary	400 r	Excellent
56	34	Female	Carcinoma of gallbladder	300 r	Excellent
57	75	Female	Carcinoma of ovary	400 r	Excellent
58	66	Female	Inoperable carcinoma of rectum	400 r	Excellent
59	71	Male			

# Peroral Administration of Vitamin B<sub>6</sub> (Pyridoxine Hydrochloride) in the Treatment of Radiation Sickness<sup>1</sup>

A OPPENHEIM, M D, and BJORN LIH, M D<sup>2</sup>

A SERIOUS complication of radiation therapy is the frequent occurrence of nausea and vomiting, commonly called radiation sickness. At times this becomes so severe that it necessitates temporary or even permanent cessation of a projected course of therapy.

Since the individual reaction to radiation is variable, one cannot predict which patient will develop radiation sickness. Empirically, the determining factors should be the size of the port, dosage, and region treated, but such is not always the case. The amount of roentgen absorption necessary to produce and maintain radiation sickness has not been determined and is probably not a constant factor. It has been our experience, however, that ill effects seldom follow treatment of peripheral ports, while irradiation of the torso, particularly the abdomen, usually produces some nausea and vomiting. We have not noted any definite relationship between nutritional status and the ability to tolerate radiation therapy.

Many theories have been advanced as to the cause of radiation sickness, and many therapeutic measures have been tried, none of which has proved entirely satisfactory. The vitamin B group has been used extensively, and with not inconsiderable success. The use of vitamin B<sub>6</sub> by Willis *et al* (1) in the nausea and vomiting of pregnancy and the uniformly good result obtained by Maxfield, McIlwain, and Robertson (2) from the intravenous administration of this drug in the treatment of radiation sickness prompted our present investigation. The intravenous route of administration, although effective, is cumbersome, time-consuming, and less suitable to a large

clinic than the peroral route. This paper is a preliminary report on the use of vitamin B<sub>6</sub> (pyridoxine hydrochloride) given *per os* to a series of 50 patients who developed nausea or vomiting, or both, during radiation therapy, or had had these symptoms during a previous course of treatment. Otherwise the patients were unselected.

After preliminary investigation, it was found that the best results were obtained when 75 to 100 mg doses were given one-half hour before meals, three or four times a day. The larger doses were chosen when treatment was given to the abdomen or chest, the smaller when treatment was directed to the pelvis or peripheral ports, such as the axilla, neck, or groin. If the dose was less than 75 mg, the maximal benefit was not obtained. Occasionally, when the drug was not retained because of vomiting, the oral dose was supplemented by intravenous medication.

Table I shows the results of peroral administration of vitamin B<sub>6</sub> in the 50 cases. Unless otherwise specified, the irradiation factors were 250 kv, 1.5 mm copper filter, 50-70 cm target-skin distance. The results were graded as follows: *Excellent (E)* when there was complete cessation of nausea and vomiting, *Good (G)* when the patient had only occasional days of distress, the symptoms being reduced at least 75 per cent by medication, *Fair*, when symptoms were reduced only 50 per cent, and finally, *Failure*, when symptoms were slightly or not at all relieved. Before the pills were given, the patients were told that the medication was for experimental purposes, and each was asked to keep a daily record of the degree of nausea, vomiting, or any other untoward symptoms that oc-

<sup>1</sup> Accepted for publication in February 1946.

<sup>2</sup> Both authors trainees of the National Cancer Institute in diagnosis and treatment of cancer, at the Memorial Hospital, New York.

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TABLE I RESULTS OF VITAMIN B<sub>6</sub> THERAPY IN 50 CASES OF RADIATION SICKNESS

Patient Age Sex	Diagnosis	Factors of X-Ray Therapy				Dose of B <sub>6</sub>	Result	Remarks
		Ports, with Size in cm	Daily Dose, r	Total Dose, r				
C D M 62	Carcinoma of nasopharynx	Peroral	3 0	200-300	4,900	75 mg t i d	E	
		L nasal	2 5	500	8,000			
Y H H F 32	Carcinoma of nasopharynx	Supra orbital	2 5	500	4,500	75 mg t i d	E	
		R zygoma	6 X 4	250	2,000			
E H F 76	Carcinoma of nasopharynx	R and L maxilla	5 (circle)	250	4,500 X 2	75 mg t i d	E	
		L upper neck	5 (circle)	250	4,500			
E B F 51	Carcinoma of breast (postop )	R zygoma	5 (circle)	250	4,500	75 mg t i d	E	
		Peroral	3 5	300	4,200			
E B F 51	Carcinoma of breast (postop )	L cheek	5 0	300	3,000	75 mg t i d	E	
		R cheek	5 0	300	3,000			
E B F 51	Carcinoma of breast (postop )	L zygoma	5 0	300	900	75 mg t i d	E	
		R zygoma	5 0	300	600			
E B F 51	Carcinoma of breast (postop )	Axilla	12 X 14	250	2,000	75 mg t i d	E	
		Ant	19 X 12	250	2,000			
E B F 51	Carcinoma of breast (postop )	Post	13 X 21	250	1,750	75 mg t i d	E	
		Dir	(Two treatments daily)					
E B F 51	Carcinoma of breast (postop )	Chest	17 X 11	500	1,500	75 mg t i d	E	Placebo given for 1 week without benefit
		Lat	27 X 12	500	1,500			
M P F 48	Carcinoma of breast (postop )	Med	(Low voltage)			75 mg q i d	E	
		As in preceding case						
M W F 43	Carcinoma of breast (postop )	As in preceding case				75 mg t i d	Failure	Symptoms aggravated
		As in preceding case						
E P F 47	Carcinoma of breast (recur- rent)	Axilla, dir	23 X 14	300	1,800	75 mg t i d	E	
		Chest, ant (low voltage)	23 X 13	300	1,800			
A H F 26	Hodgkin's disease	Mediastinum	(One treatment daily)			75 mg t i d	E	
		Ant	17 X 12	300	1,800			
C A F 37	Hodgkin's disease	Post	18 X 12	300	1,800	75 mg t i d	E	
		Mediastinum	(One port treated daily)					
C A F 37	Hodgkin's disease	Ant	15 X 11	100	400	75 mg t i d	E	
		Post	15 X 11	100	400			
M A W F 20	Hodgkin's disease	Chest, lat	12 X 9	200	800	75 mg t i d	E	
		Mediastinum	(One port treated daily)					
M A W F 20	Hodgkin's disease	Ant	14 X 8	200	800	75 mg t i d	E	
		Post	19 X 6	200	800			
M B M 25	Hodgkin's disease	Chest, lat	11 X 10	200	800	75 mg t i d	G	
		L neck	15 X 11	200	1,800			
M B M 25	Hodgkin's disease	R neck	15 X 14	200	1,800	75 mg t i d	G	
		Mediastinum	(One neck and one mediastinal port treated daily)					
M B M 25	Hodgkin's disease	Ant	13 X 8	200	1,800	75 mg t i d	G	
		Post	13 X 0	200	1,800			

Case No.	Diagnosis	Site of Lesion	Field Size	Dose	Reaction	Notes
I 53	Lympho-sarcoma	R axilla	10 X 8	900		
		L axilla	12 X 11	300		
		R lower chest	19 X 18	400		
		Ant	13 X 17	400		
		Post				
		R upper chest	11 X 11	400		
		Ant	13 X 19	400		
		Post	16 X 12	400		
		R. chest, lat.	5 (circle)	300		
		L neck	16 X 16	2,400		
		Epigastrium	18 X 16	2,400		
		Ant	18 X 8	2,400 X 2		
		Post	25 X 8	2,400 X 2		
		Two ant. ports				
		Two post. ports				
		R upper chest	15 X 10 (oval)	300		
		Ant. and post (1,000 kv)				
		As in preceding case				
		Right apex	10 (circle)	350		
		Ant. and post (1,000 kv)	9 (circle)	2,450		
		R. suprascapular	10 X 9	300		
		R. chest Ant and post	10 X 15	3,000 X 2		
		L chest Ant and post				
		1,000 kv	10 X 10	200		
		Two ant chest ports	12 X 12	200		
		Two post ports (Two ports treated daily)				
		L chest	19 X 11	500		
		R chest	17 X 14	200		
		Ant and post	12 X 16	250		
		Sternum	14 X 13	300		
		R axilla	30 X 18	400		
		R pelvis	19 X 17	300		
		Stomach Ant and post				
		Stomach	13 X 13	200-250		
		Ant and post	20 X 15	300		
		Stomach	18 X 21	300		
		Ant and post				
		Mid-abdomen	17 X 18	400		
		R lower abdomen	18 X 16	400		
		Central abdominal ports	13 X 12	200		
		2 ant, 2 post	19 X 12	300		
		L neck				
		Central trunk	17 X 9	200		
		3 ant, 3 post.				
		R ilium	13 X 11	300		
		Ant	19 X 17	300		
		Post				
		As in preceding case				
		Right apex	10 (circle)	350		
		Ant. and post (1,000 kv)	9 (circle)	2,450		
		R. suprascapular	10 X 9	300		
		R. chest Ant and post	10 X 15	3,000 X 2		
		L chest Ant and post				
		1,000 kv	10 X 10	200		
		Two ant chest ports	12 X 12	200		
		Two post ports (Two ports treated daily)				
		L chest	19 X 11	500		
		R chest	17 X 14	200		
		Ant and post	12 X 16	250		
		Sternum	14 X 13	300		
		R axilla	30 X 18	400		
		R pelvis	19 X 17	300		
		Stomach Ant and post				
		Stomach	13 X 13	200-250		
		Ant and post	20 X 15	300		
		Stomach	18 X 21	300		
		Ant and post				
		Mid-abdomen	17 X 18	400		
		R lower abdomen	18 X 16	400		
		Central abdominal ports	13 X 12	200		
		2 ant, 2 post	19 X 12	300		
		L neck				
		Central trunk	17 X 9	200		

TABLE I RESULTS OF VITAMIN B<sub>12</sub> THERAPY IN 50 CASES OF RADIATION SICKNESS (Continued)

Patient Age Sex	Diagnosis	Factors of X-Ray Therapy			Dose of B <sub>12</sub>	Result	Remarks
		Ports, with Size in cm	Daily Dose, r	Total Dose, r			
M S (Cont.)							
J R P 47	Lymphosarcoma	Central abdomen Ant and post (One iliac and one abdominal port treated daily)	12 X 12 300	900 X 2	75 mg t i d	E	
V T M 31	Lymphosarcoma	Epigastrium Ant and post R and L axilla R and L lower quadrants Central abdomen	19 X 9 12 X 10 17 X 12 100-300	200 X 2 600 X 2 1,450 X 2	75 mg t i d	E	
M B P 28	Lymphosarcoma	Ant and post Spleen Ant and post R groin 8 abdominal ports	20 X 8 12 X 9 12 X 16 13 X 7 to 19 X 11	600 X 2 100 300 X 2 900 5,800	100 mg q i d	Failure	
R F P 42	Carcinoma of sigmoid, inoperable, colostomy	R and L lower quadrant	15 X 15	2,100 X 2	75 mg q i d	Fair	
L O P 39	Carcinoma of breast metastasizing to bone	Dorsal spine Lumbar spine 4 pelvic ports	18 X 13 16 X 13 20 X 20	1,400 1,400 1,200 X 4	100 mg t i d	G	
H B M 31	Teratoma testis	L groin and scrotum Abdominal ports 2 ant and 2 post (Two abdominal ports treated daily)	17 X 12 18 X 12 17 X 11	1,000 2,100	100 mg q i d	Failure	
G W P 38	Carcinoma of ovary	4 pelvic and low abdominal ports (Two ports treated daily)	17 X 11 250	2,000 X 4	75 mg q i d	E	Daily vomiting during previous series
G B P 53	Carcinoma of ovary	4 pelvic and 4 abdominal ports (1,000 kv)	10 X 12 250 X 2	1,000 X 8	75 mg t i d	G	
P 43	Carcinoma of ovary	4 pelvic and 4 abdominal ports (1,000 kv)	14 X 12 250 X 2	1,000 X 8	100 mg t i d	E	
T S P 40	Carcinoma of ovary	R ant abdomen L ant abdomen R and L lower abdomen	23 X 16 300 19 X 19 300	1,800 1,800 2,100 X 2	75 mg q i d	E	
B Z P 34	Carcinoma of ovary	6 pelvic ports	23 X 15 14 X 11	2,100 X 2 1,000 X 6	75 mg t i d	Failure	
M W P 39	Carcinoma of fundus (postop)	4 pelvic ports	17 X 13 250 X 2	2,000 X 4	75 mg t i d	Failure	
P E P 63	Carcinoma of fundus	4 pelvic ports	10 X 12 250 X 2	1,750 X 4	100 mg t i d	E	
S M P 38	Carcinoma of cervix	4 pelvic ports	15 X 12 250 X 2	2,000 X 4	75 mg t i d	Fair	
B M P 45	Carcinoma of cervix	6 pelvic ports	14 X 11 250 X 2	2,000 X 6	75 mg t i d	E	
I J P 34	Carcinoma of cervix	6 pelvic ports	14 X 11 250 X 2	1,750 X 6	75 mg t i d	E	
G M P 41	Carcinoma of cervix	6 pelvic ports	14 X 11 250 X 2	1,750 X 6	75 mg t i d	E	
L B P 43	Carcinoma of cervix	6 pelvic ports	14 X 11 250 X 2	1,750 X 6	75 mg t i d	E	
P 43	Carcinoma of cervix	6 pelvic ports	14 X 11 250 X 2	1,750 X 6	75 mg t i d	E	

curred. They were seen frequently during the period of observation. An effort was made to evaluate the pharmacological action of the drug as distinct from the psychological effect manifest in taking pills, keeping of records, and the personal attention involved.

From Table I, it will be seen that in 30 cases (60 per cent) results were excellent, in 6 (12 per cent) good, in 8 (16 per cent) fair, while there were 6 (12 per cent) failures. Five of the 6 failures, as shown in Table II, occurred when the abdomen was irradiated, although 8 of the 21 cases so treated showed excellent results. This confirms our previous observation that treatment over the abdomen is more apt to produce nausea and vomiting than irradiation of any other body region, and the symptoms are more difficult to control with vitamin B<sub>6</sub>.

It was found that those who failed to respond to the initial dosages calculated for the various body regions did not improve even though larger doses were given. On the other hand, a number of patients, once nausea and vomiting were controlled, were able to continue treatment for some time without pills, and then required lesser amounts for control of recurrent symptoms.

In a few cases, a placebo was substituted for the vitamin B<sub>6</sub> after symptoms had been alleviated by the latter drug. Symptoms always recurred, but were controlled again with resumption of the vitamin administration.

No significant alteration in blood pressure was noted.

The symptoms of radiation sickness were aggravated in one patient following the administration of vitamin B<sub>6</sub>. In one pa-

TABLE II RESULTS OF VITAMIN B<sub>6</sub> THERAPY IN 50 CASES OF RADIATION SICKNESS SUMMARIZED

Body Region Treated	Number of Cases	Number Excellent	Number Good	Number Fair	Number, Failures
Head, Neck	3	3	0	0	0
Breast	4	3	0	0	1
Chest	16	11	4	1	0
Abdomen	21	8	2	6	5
Pelvis	6	5	0	1	0
TOTAL	50	30 (60%)	6 (12%)	8 (16%)	6 (12%)

tient a scaly and follicular type of eruption developed, which disappeared on withdrawal and reappeared on readministration of the drug.

#### CONCLUSION

A preliminary report is presented on the peroral use of vitamin B<sub>6</sub> (pyridoxine hydrochloride) in the treatment of radiation sickness in a series of 50 cases. A significantly high percentage of favorable results was obtained.

**ACKNOWLEDGMENTS** The authors are indebted to Merck & Co., Inc., Rahway, N. J., for the vitamin B<sub>6</sub> (pyridoxine hydrochloride) used in this study. They are also grateful to the attending physicians of the various services at Memorial Hospital for furnishing them with the clinical material, and to the technicians of the Radiation Department for their co-operation.

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TABLE I RESULTS OF VITAMIN B<sub>6</sub> THERAPY IN 50 CASES OF RADIATION SICKNESS (Continued)

Patient Age Sex	Diagnosis	Factors of X-Ray Therapy			Dose of B <sub>6</sub>	Result	Remarks
		Ports, with Size in cm	Daily Dose, r	Total Dose, r			
M S (Cont.)							
J R F 47	Lymphosarcoma	Central abdomen Ant and post (One iliac and one abdominal port treated daily)	12 X 12	300	900 X 2	E	
V T M 31	Lymphosarcoma	Epigastrium Ant and post R and L axilla R and L lower quadrants	10 X 0 12 X 10 17 X 12	100 300 100-300	200 X 2 000 X 2 1,450 X 2	E	
M B F 28	Lymphosarcoma	Central abdomen Ant and post	20 X 8	200	600 X 2	Failure	
R F F 42	Carcinoma of sigmoid, upper	Spleen Ant and post	12 X 0	100	300 X 2	Fair	
L O F 39	Carcinoma of breast metastasizing to bone	R groin 8 abdominal ports	12 X 10 13 X 7 to 19 X 11	300 75-200	900 5,800	G	
H B M 31	Teratoma testis	R and L lower quadrant	15 X 15	300	2,100 X 2	Failure	
G W F 38	Carcinoma of ovary	Dorsal spine Lumbar spine 4 pelvic ports L groin and scrotum Abdominal ports 2 ant and 2 post (Two abdominal ports treated daily)	18 X 13 16 X 13 20 X 20 17 X 12	350 350 400 500	1,400 1,400 1,200 X 4 1,000	Daily vomiting during previous series	
G B F 53	Carcinoma of ovary	4 pelvic and 4 abdominal ports (1,000 kv)	18 X 12 17 X 11	300 250	2,100 2,000 X 4	E	
F L F 43	Carcinoma of ovary	4 pelvic and 4 abdominal ports (1,000 kv)	10 X 12	250 X 2	1,000 X 8	G	
T S F 40	Carcinoma of ovary	R ant abdomen L ant abdomen	14 X 12 23 X 10	250 X 2 300	1,000 X 8 1,800	E	
B Z F 34	Carcinoma of ovary	R and L lower abdomen	19 X 19 23 X 15	300 300	1,800 2,100 X 2	E	
M W F 39	Carcinoma of fundus (postop)	6 pelvic ports	14 X 11	350 X 2	1,000 X 6	Failure	Rash developed
F E F 63	Carcinoma of fundus	4 pelvic ports	17 X 13	250 X 2	2,000 X 4	E	
S M F 38	Carcinoma of cervix	4 pelvic ports	16 X 12	250 X 2	1,750 X 4	Fair	
B M F 45	Carcinoma of cervix	4 pelvic ports	15 X 12	250 X 2	2,000 X 4	E	
I J F 34	Carcinoma of cervix	6 pelvic ports	14 X 11	250 X 2	2,000 X 6	E	
G M F 41	Carcinoma of cervix	6 pelvic ports	14 X 11	250 X 2	1,750 X 6	E	
F 4 F 4		6 pelvic ports	14 X 11	250 X 2	1,750 X 6	E	
R 1 R 1		6 pelvic ports	14 X 11	250 X 2	1,750 X 6	E	

Name, Age, Sex, Date X-Ray Therapy B <sub>4</sub> in	Diagnosis	X-Ray Treatments	Vit B <sub>4</sub> Intravenously and 50 mg Nicotinic acid t i d	Symptoms					Results
				Nausea	Vomiting	Diarrhea	Appetite	Others	
1 L W 49 Y 7/30/45	Carcinoma of right breast	Supra and inframammary regions and posterior part of right axilla Areas 15 X 15 cm, 150 r to 2 areas for 2 days Later, 300 r to each area, 5 days weekly Total 1,800 r to each area Pelvis anterior and posterior regions, right and left Areas 15 X 15 cm, 300 r to 2 areas, 5 days weekly Total 1,650 r to ant and 1500 r to post regions Pelvis anterior and posterior regions, right and left 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 1,500 r to each area	8/6/45 25 mg B <sub>4</sub>	8/6/45	No	No	Fair	None	Complete relief 8/6 No symptoms after that date
2 L M W 41 F 11/5/45	Carcinoma of cervix	Pelvis anterior and posterior regions, right and left Areas 15 X 15 cm, 300 r to 2 areas, 5 days weekly Total 1,650 r to ant and 1500 r to post regions Pelvis anterior and posterior regions, right and left 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 1,500 r to each area	25 mg B <sub>4</sub> immediately after each treatment	No	No	No	Normal	None	No nausea, vomiting, or other symptoms
3 V C 32 F 8/1/45	Carcinoma of cervix	Pelvis anterior and posterior regions, right and left 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 1,500 r to each area	8/1/45 25 mg B <sub>4</sub>	No	No	No	Fair	None	No nausea, vomiting, or other symptoms
4 W F 40 F 8/8/45	Carcinoma of cervix	Pelvis anterior and posterior regions right and left Areas 15 X 15 cm, 300 r to 2 areas, 5 days weekly Totals 1,800 r to anterior regions, 1,500 r to posterior regions Left leg and thigh 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 2,100 r to leg, 2,400 r to thigh	8/21/45 25 mg B <sub>4</sub>	Slight 8/21	No	No	Fair	None	Nausea relieved completely 8/21 after administration of vitamins No symptoms after that
5 S S 51 F 8/21/45	Sarcoma of left leg	Left leg and thigh 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 2,100 r to leg, 2,400 r to thigh	25 mg B <sub>4</sub> immediately after each treatment	No	No	No	Fair	Pain in left extremity	No nausea, vomiting, or other symptoms
6 D W R 59 M 9/12/45	Carcinoma of prostate with metastasis to urinary bladder	Hypogastric region, right and left side, anterior and posterior Areas 10 X 10 cm anterior, 15 X 15 cm posterior, 300 r to 2 areas Total 2100 r anterior regions, 1,600 r posterior regions	25 mg B <sub>4</sub> immediately after each treatment	No	No	Slight 9/26	Good	None	Diarrhea controlled with bismuth subcarbonate

Table cont on p. 888

# Pyridoxine Hydrochloride (Vitamin B<sub>6</sub>) in the Control of Radiation Sickness: Preliminary Report

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SINCE 1934, we have used the protracted fractionated method of deep x-ray therapy in the treatment of practically all types of malignant neoplasms that have been referred to us for treatment. As in most general radiological clinics, carcinomas of the uterine cervix and breast are by far the most frequent types of lesion encountered. From 1934 to 1941, we used the old Drum type of equipment unit, operating at 200 kv p, 5 ma, 50 cm distance, 0.5 mm Cu plus 1.0 mm Al filter, with an output of 17 r per minute in air, not including back-scatter. During that seven-year period, the control of x-ray sickness was quite a problem. We used face masks (1), nembutal (2), fruit juices (3), good ventilation of therapy rooms (4), and many other measures recommended by various authors, with variable results.

In 1941, we installed a modern shock-proof 220-kv p unit, operating at 200 kv, 20 ma, 50 cm distance, and an r output of 50 per minute, with 0.5 mm Cu plus 1.0 mm Al filtration. From that time on, radiation sickness ceased to be a major problem unless we increased our daily dose from 300 to 500 or 600 r. It was about this time that we began to administer nicotinic acid (5) and thiamine chloride (6) routinely to patients receiving 200 kv x-ray therapy. This probably helped to prevent some cases of radiation sickness, but in other instances it was wholly ineffective.

It is generally recognized that the larger the daily dose of radiation with a 200-kv unit, the greater is the possibility of x-ray sickness. The size of the field, the

area treated, and the general nutritional state of the patient also play important roles (7). It has been our experience that when two areas of the pelvis or breast are treated, with fields up to 15 × 15 cm. and a daily dosage of 150 r measured in air to each area, severe radiation sickness rarely develops, provided proper attention is given to the patient's general nutritional state (8). Diarrhea practically never occurs under these circumstances. If, however, the epigastric area or right and left hypochondriac regions are treated with 150 r, using 15 × 15 cm fields, radiation sickness occurs much more frequently and usually requires special attention if therapy is to be continued (see Case 18). Lesions of the extremities can be given large doses of radiation without signs of radiation sickness (see Case 5).

In April 1945, we decided to double the daily x-ray dosage of 300 r, so as to give 600 r. In this way we hoped to decrease the time necessary for adequate treatment of cases of carcinoma in the hospital, to make possible a more rapid turnover of cases, and to reduce the hospital expenses proportionately.

Economics plays an important part in the management of any type of malignant disease, especially among people whose average economic status is low. Two questions immediately confronted us: (1) How could we control the x-ray sickness that we felt would most probably develop? (2) Would the end-results be equally good? It is the purpose of this paper to answer the first question. Obviously, we cannot answer the second until more time has elapsed.

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<sup>2</sup> Chairman of the Department of Radiology and Professor of Radiology of Meharry Medical College. Radiologist, George W. Hubbard Hospital.

<sup>3</sup> Teaching Fellow in Radiology, Meharry Medical College.



Name Age Sex, Date X-Ray Therapy Began	Diagnosis	X-Ray Treatments	Vit B <sub>6</sub> Intravenously and 50 mg Nicotinic acid t i d	Symptoms					Results
				Nausea	Vomiting	Diarrhea	Appetite	Others	
1 L W 60 l 7/30/45	Carcinoma of right breast	Supra and inframammary regions and posterior part of right axilla Areas 15 X 15 cm, 150 r to 2 areas for 2 days Later, 300 r to each area, 5 days to each area, 5 days weekly Total 1,800 r to each area Pelvis anterior and posterior regions, right and left Areas 15 X 15 cm, 300 r to 2 areas, 5 days weekly Total 1,050 r to ant and 1500 r to post regions Pelvis anterior and posterior regions, right and left 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 1,500 r to each area	8/6/45 25 mg B <sub>6</sub>	8/6/45	No	No	Fair	None	Complete relief 8/6 No symptoms after that date
2 E M W 41 F 11/5/45	Carcinoma of cervix		25 mg B <sub>6</sub> immediately after each treatment	No	No	No	Normal	None	No nausea, vomiting, or other symptoms
3 V C 32 F 8/1/45	Carcinoma of cervix		8/1/45 25 mg B <sub>6</sub>	No	No	No	Fair	None	No nausea, vomiting, or other symptoms
4 W F 40 F 8/8/45	Carcinoma of cervix		8/21/45 25 mg B <sub>6</sub>	Slight 8/21	No	No	Fair	None	Nausea relieved completely 8/21 after administration of vitamin No symptoms after that
5 S S 51 F 8/21/45	Sarcoma of left leg	Left leg and thigh 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 2,100 r to leg, 2,400 r to thigh Hypogastric region, right and left side, anterior and posterior Areas 10 X 10 cm anterior, 15 X 15 cm posterior, 300 r to 2 areas Total 2,100 r anterior regions, 1,500 r posterior regions	25 mg B <sub>6</sub> immediately after each treatment	No	No	No	Fair	Pain in left extremity	No nausea, vomiting, or other symptoms
6 D W R 59 M 9/12/45	Carcinoma of prostate with metastasis to urinary bladder		25 mg B <sub>6</sub> immediately after each treatment	No	No	Slight 9/26	Good	None	Diarrhea controlled with bismuth subcarbonate

Table cont on p 388

TABLE I PROPHYLACTIC USE OF PYRIDOXINE H<sub>2</sub> HYDROCHLORIDE (VITAMIN B<sub>6</sub>) FOR RADIATION SICKNESS REVIEW OF 20 CASES (Continued)

Name, Age, Sex, Date X-Ray Ther- apy Begun	Diagnosis	X-Ray Treatments	Vit B <sub>6</sub> Intra- venously and 50 mg Nicotinic Acid t.i.d.	Symptoms					Results
				Nausea	Vomit- ing	Diar- rhea	Appe- tite	Others	
7 E M 30 F 10/1/45	Carcinoma of cervix	Pelvis left and right, anterior and poste- rior, 300 r to 2 areas, 15 X 15 cm., 5 days weekly Total 1,500 r to each area	25 mg B <sub>6</sub>	No	No	No	Good	None	No nausea, vomit- ing, or other symptoms
8 L L 52 F 10/9/45	Carcinoma of cervix	Pelvis anterior and posterior regions, right and left Areas 15 X 15 cm., 300 r to 2 areas, 5 days weekly Total 1,500 r anterior regions, 1,200 r posterior re- gions	25 mg B <sub>6</sub> im- mediately af- ter each treat- ment	No	No	No	Good	None	No nausea, vomit- ing, or other symptoms
9 S W 50 F 10/13/45	Carcinoma of cervix	Pelvis anterior and posterior regions, left and right Areas 15 X 15 cm., 300 r to 2 areas, 5 days weekly Total 1,500 r to each area	25 mg B <sub>6</sub> im- mediately af- ter each treat- ment	No	No	No	Good	None	No nausea, vomit- ing, or other symptoms
10 A W 58 M 10/10/45	Carcinoma of rectum	Pelvis anterior and posterior regions, right and left, 200 r to 2 areas, 10 X 15 cm., posterior re- gion, alternating with 300 r to one anterior area, 5 days weekly Total 1,500 r to each region	25 mg B <sub>6</sub> im- mediately af- ter each treat- ment	No	No	No	Good	None	No nausea, vomit- ing, or other symptoms
11 H P 31 M 10/17/45	Sarcoma of but- tocks	300 r to one area, 15 X 15 cm., on each but- tock 17th and 18th days Later, 300 r to left buttock, 5 days weekly, 600 r to right buttock 23rd day Total 1,200 r to right and 1,800 r to left buttock	25 mg B <sub>6</sub> im- mediately af- ter each treat- ment	No	No	No	Good	Pain at site of tumor	No nausea, vomit- ing, or other symptoms, except pain at site of tumor

A J  
70 F  
10/17/45Carcinoma of  
left breast  
with metas-  
tasis to axilla

Infr. axillary region  
and left axilla treated  
r to each area, 10 X  
10 cm up to 10/24  
Later, both regions  
treated 5 days  
weekly Total 1,500 r  
r to each region One  
area, 7 X 7 cm, in  
the left supraclavicu-  
lar region up to 10/-  
24 Total 1,800 r  
Pelvis right and left,  
anterior and poste-  
rior, 300 r to 2  
areas, 15 X 15 cm, 5  
days weekly up to  
25th day Later,  
150 r to 2 areas,  
5 days weekly up to  
11/3 Total 1,800 r  
to anterior regions,  
1,200 r to posterior  
regions

25 mg B<sub>6</sub> im-  
mediately af-  
ter each treat-  
ment

No

No

Fair

None

No nausea vomit-  
ing, or  
symptoms13 M L W  
33 F  
10/21/45Carcinoma of  
cervix

25 mg B<sub>6</sub> im-  
mediately af-  
ter each treat-  
ment

No

No

Fair

General weak-  
ness and in-  
disposition

The large doses were  
discontinued 10/-  
27, because the  
patient began to  
have a fever of 102  
to 106° F during  
the days preced-  
ing the treatment  
The fever ceased  
when the treat-  
ment was suspend-  
ed on the 27th  
and 28th days, and  
did not recur after  
treatments were  
resumed with 150  
r to both areas, 5  
days weekly

14 M  
45 M  
10/27/45Carcinoma of  
stomach

Epigastrium right and  
left regions Areas 10  
X 15 cm treated on  
27th day, areas 10 X  
10 cm treated 28th  
day, 300 r to 2 areas  
for 2 days

25 mg B<sub>6</sub> im-  
mediately af-  
ter each treat-  
ment

No

Good

Indisposition  
and weakness

The nausea was not  
completely re-  
lieved, but pa-  
tient, who also  
complained of gas  
in the stomach,  
improved after  
taking B<sub>6</sub>  
Nausea permanently  
relieved

15 L A D  
18 M  
11/1/45Papilloma of  
urinary blad-  
der

Vesical region anterior,  
right and left, 300 r  
to 1 area, 10 X 10  
cm, 5 days weekly  
Total 1,500 r to  
each area

25 mg B<sub>6</sub> im-  
mediately fol-  
lowing treat-  
ments on 11/-  
8, 11/10, 11/-  
12, 11/13

Moderate  
11/8

Fair

None

Nausea permanently  
relieved after 11/716 A A  
30 F  
11/5/45Carcinoma of  
cervix

Pelvis anterior and  
posterior regions,  
right and left Areas  
10 X 15 cm, 150 r  
to 2 areas, 5 days  
weekly Total 900  
r to anterior region,  
750 r posterior

25 mg B<sub>6</sub> im-  
mediately af-  
ter the treat-  
ments on 11/-  
5 and 11/6,  
50 mg from  
7th day on

Slight  
11/5 and  
11/10  
Moderate  
11/7  
Absent  
thereafter

Fair

None

Nausea permanently  
relieved after 11/7

TABLE 1 PROPYLACTIC USE OF PYRIDOXINE HYDROCHLORIDE (VITAMIN B<sub>6</sub>) FOR RADIATION SICKNESS REVIEW OF 20 CASES (Continued)

Name, Age, Sex, Date X-Ray Therapy Begun	Diagnosis	X-Ray Treatments	Vit B <sub>6</sub> Intravenously and 50 mg Nicotinic Acid t i d	Symptoms					Results
				Nausea	Vomiting	Diarrhea	Appetite	Others	
17 A C N 44 y 11/12/45	Carcinoma of right breast with metastasis to right axillary nodes	Superior and inferior regions of breast and posterior axillary region, 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 1,500 r to each area	25 mg B <sub>6</sub> immediately after treatment 11/13, 50 mg 11/14 and after	Moderate 11/13, slight, 11/14	No	No	Fair	None	Partial relief of nausea 11/13, permanent and complete relief 11/14
18 F W 70 y 11/23/45	Carcinoma of left breast with metastasis to liver	Superior and inferior left breast and posterior left axilla, 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 900 r to each region Superior, inferior, right and left, on upper part of abdomen Total 900 r anterior and 750 posterior, to each area, respectively	25 mg B <sub>6</sub> immediately after treatment on 12/19, 50 mg 12/20, 75 mg 12/21, 125 mg 12/22, 50 mg 12/26 and 12/27	Severe	Absent until 12/23, then daily stools, until 12/28 Absent thereafter	Constipation, then normal stools, then diarrhea	Poor	Pain in epigastrium, constipation except one day	Nausea partially relieved immediately with B <sub>6</sub> . Vomiting occurred as soon as B <sub>6</sub> was suspended, 12/23. Diarrhea relieved with sub-carbonate of bismuth
19 P L 38 y 12/6/45	Round-cell sarcoma of abdomen	Superior, inferior, right and left anterior abdomen, 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 1,800 r to each area	25 mg B <sub>6</sub> immediately after each treatment except 12/7	Slight 12/10	No	No	Good	Constipation with tendency to progressive increase in frequency of stools	Slight nausea 12/10
20 M J M 41 y 12/12/45	Carcinoma of cervix	Anterior and posterior, right and left pelvis, 300 r to 2 areas 15 X 15 cm, 5 days weekly Total 1,500 r to anterior regions, 1,250 r to posterior regions	25 mg B <sub>6</sub> 12/14 only	Moderate 12/14	No	No	Good	None	Complete and permanent relief of nausea 30 minutes after administration of B <sub>6</sub> , 12/14. No other symptoms on or after that day

and comparisons can be made with other groups treated with smaller dosages. Kaplan (9), however, recommends 1,000 to 2,000 r in from ten days to two weeks as pre-radium x-ray therapy in carcinoma of the cervix. This became the basis of our modified massive dose technic. The four breast cases included in our chart were all inoperable and hopeless, and radiation therapy was given only for palliation.

Maxfield, McIlwain, and Robertson (10) reported excellent results with pyridoxine hydrochloride (vitamin B<sub>6</sub>) in over 50 cases of radiation sickness. We decided to use this drug in addition to 50 mg of nicotinic acid t.i.d. We also decided to give 25 mg of pyridoxine hydrochloride intravenously immediately after each x-ray treatment, without waiting for symptoms to develop as the above authors had done.

Up to the present, we have used an x-ray dose of 600 r together with 25 mg of pyridoxine hydrochloride, administered intravenously, in about 35 cases. The accompanying table shows the results in the first 20 cases (in one of these only 300 r per treatment were given). The majority of these patients were treated five times weekly, allowing them to rest on Saturday and Sunday. Up to the present the clinical response has been the same as when only 300 r were given, except that more cases of diarrhea have occurred. Treatment with a few doses of bismuth subcarbonate was effective in controlling that symptom in practically all instances.

All patients included in this report were American Negroes. Whether race is a factor in the frequency of radiation sickness is beyond the scope of this paper, but we have never had the high incidence of radiation sickness (50 per cent) reported by some writers (11).

In 5 of the 20 reported cases the patients were ambulatory and we felt that more than ordinary care had to be exercised in this group. Each of these patients was

carefully questioned every day regarding nausea, vomiting, anorexia, diarrhea, or other suggestive symptoms. Only one reported some nausea and vomiting (Case 16). Incidentally, this is the patient who received 300 r per treatment, mentioned above. With increase of the dosage of pyridoxine hydrochloride to 50 mg she experienced no further trouble.

#### SUMMARY

By increasing the daily x-ray dosage from 300 to 600 r and administering pyridoxine hydrochloride, we succeeded in reducing the treatment time for various types of malignant growth by approximately one-half and at the same time prevented the development of radiation sickness.

NOTE: The pyridoxine hydrochloride used in this investigation was kindly furnished by E. R. Squibb & Sons.

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TABLE 1 PROPHYLACTIC USE OF PYRIDOXINE HYDROCHLORIDE (VITAMIN B<sub>6</sub>) FOR RADIATION SICKNESS REVIEW OF 20 CASES (Continued)

Nausea, Age, Sex, Date X-Ray Therapy Begun	Diagnosis	X-Ray Treatments	Vit B <sub>6</sub> Intravenously and 50 mg Nicotinic Acid t i d	Symptoms				Results
				Nausea	Vomiting	Diarrhea	Appetite	
17 A C N 44 F 11/12/45	Carcinoma of right breast with metastasis to right axillary nodes	Superior and inferior regions of breast and posterior axillary region, 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 1,500 r to each area	25 mg B <sub>6</sub> immediately after treatment 11/13, 50 mg 11/14 and after	Moderate 11/13, slight, 11/14	No	No	Fair	Partial relief of nausea 11/13, permanent and complete relief 11/14
18 F W 70 F 11/23/45	Carcinoma of left breast with metastasis to liver	Superior and inferior left breast and posterior left axilla, 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 900 r to each region Superior, inferior, right and left, on upper part of abdomen Total 900 r anterior and 750 posterior, to each area, respectively	25 mg B <sub>6</sub> immediately after treatment on 12/19, 50 mg 12/20, 75 mg 12/21, 125 mg 12/22, 50 mg 12/26 and 12/27	Severe	Absent until 12/23, then daily until 12/28 Absent thereafter	Constipation, then normal stools, then diarrhea	Poor	Nausea partially relieved immediately with B <sub>6</sub> . Vomiting occurred as soon as B <sub>6</sub> was suspended, 12/23 Diarrhea relieved with sub-carbonate of bismuth
19 P L 38 F 12/6/45	Round-cell sarcoma of abdomen	Superior, inferior, right and left anterior abdomen, 300 r to 2 areas, 15 X 15 cm, 5 days weekly Total 1,800 r to each area	25 mg B <sub>6</sub> immediately after each treatment except 12/7	Slight 12/10	No	No	Good	Slight nausea 12/10
20 M J M 41 F 12/12/45	Carcinoma of cervix	Anterior and posterior, right and left pelvis, 300 r to 2 areas 15 X 15 cm, 5 days weekly Total 1,550 r to anterior regions, 1,350 r to posterior regions	25 mg B <sub>6</sub> 12/14 only	Moderate 12/14	No	No	Good	Complete and permanent relief of nausea 30 minutes after administration of B <sub>6</sub> 12/14 No other symptoms on or after that day

selection of patients, except that those whose symptoms could be "cured" by smelling aromatic spirits of ammonia or other such medication were excluded

Patients with carcinoma of the cervix were treated with 200-kv x-rays through six external ports, with the addition of intravaginal therapy in a few instances. Those with carcinoma of the colon (all of them rectal lesions) received 400-kv therapy through one anterior and two posterior ports over the involved area, except in case 31, in which radiation was given over the liver for metastasis. For Marie-Strumpell arthritis, 140-kv therapy was used, directed to three spinal and sacroiliac ports. Carcinoma of the breast was treated through one anterior and one posterior port in the axillary regions, with 200-kv therapy. Patients with Hodgkin's disease, lymphosarcoma, undifferentiated carcinoma, etc., received appropriate therapy over the indicated areas with 140- or 200-kv x-rays.

The antispasmodic drug, trasantine (75 mg per tablet), was used initially on 26 patients, with a dosage range from 225 to 1,000 mg per day in divided doses. Thirty-two patients were then treated with trasantine-phenobarbital in doses of 1 or 2 tablets three times a day. Inasmuch as a trasantine-phenobarbital tablet contains 20 mg of trasantine plus 20 mg of phenobarbital, and since a trasantine tablet alone contains 75 mg of the drug, it was thought that nausea and diarrhea might be controlled even more effectively if additional antispasmodic therapy were provided along with the phenobarbital. A small group of patients, therefore, complaining principally of those symptoms were treated with trasantine-phenobarbital, 1 tablet three times a day, plus trasantine in doses of 1 to 3 tablets (75 mg each) three or four times a day. Results in this small series of 7 patients were gratifying.

This form of medication was selected because tablets are easy for most people to take, and the necessity of parenteral therapy is eliminated. Trasantine is non-

habit-forming, and with the amount of phenobarbital contained in trasantine-phenobarbital tablets, the danger of barbiturate habituation is reduced to a minimum. Trasantine is an effective intestinal antispasmodic as shown by a number of workers (18). It has all of the desirable actions of both atropine and papaverine but is essentially devoid of the undesirable side-effects of the former drug on the heart, pupil, accommodation, and the salivary glands (3, 9, 15).

#### DISCUSSION

As shown in the accompanying table, 6 patients failed to gain relief from the use of either trasantine or trasantine-phenobarbital. Two of these had carcinoma of the cervix in terminal stages. One had recently been operated upon for carcinoma of the rectum and an ileostomy had been performed. In 3 patients who failed to respond to trasantine, diarrhea was also unrelieved by large doses of tincture of opium.

Five patients either stopped taking the drug after symptoms were relieved or consumed their entire supply and went for a time without obtaining more. Each of these experienced a return of previous symptoms, which were again relieved upon resuming trasantine medication.

Two patients who had previously received pyridoxine hydrochloride (vitamin B<sub>6</sub>) without benefit obtained complete relief with trasantine. There was only one complaint relative to the administration of trasantine, namely that the tablets were "too sweet." The patient continued taking the drug, however, and obtained relief.

The pain complained of by some of the patients was described in each instance as "gripping," which conforms to Kallet's (10) statement that "much of the tenesmus is due to sphincter spasm." In all of these cases moderate to complete relief was obtained.

In those patients who exhibited considerable apprehension, the use of trasantine-phenobarbital was of considerable value, in accord with the well recognized fact that

# Treatment of Radiation Sickness with Trasentine and Trasentine-Phenobarbital Preliminary Report<sup>1</sup>

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IT IS WELL KNOWN that x-ray therapy injures healthy as well as malignant cells. According to Kallet and Thorstad (10), this injury is anatomically manifested by an initial edema as a result of damage to connective tissue and blood vessels. With further trauma, an endarteritic process develops, with thickening of the walls and a gradual decrease in the size of the lumen of the intestine.

The most distressing symptoms which follow intensive irradiation are nausea (sometimes vomiting) and diarrhea, frequently accompanied by pain and evidence of urinary bladder irritation. Such symptoms are seen particularly in those patients receiving radiation to the pelvic area, because of the anatomic proximity of the lower intestine to the uterus and the frequency with which x-ray therapy is employed for the treatment of carcinoma in or about the latter organ.

The cause of these sequelae remains an enigma, although it seems possible that they may be due to a direct action of the x-rays on the rectum and/or sigmoid colon, urinary bladder, and probably some portions of the small bowel.

Many factors, ranging from the psychic effect of the mechanical apparatus employed, with its attendant noise and accompanying odors, to blood electrolyte alterations and vitamin deficiencies, have been offered as explanations. Goldman (5) has described disturbances in both nitrogen and inorganic chloride balance and has shown that changes in the latter are associated with irradiation sickness, while Bean, Spies, and Vilter (1) reached the conclusion that persons on an inadequate diet are more prone to have untoward symptoms following x-ray therapy than are those who are adequately nour-

ished. Mitchell (14) has described nucleic acid and carbohydrate metabolism alterations, and, though he does not correlate these with radiation sickness, it is certainly within the realm of possibility that they may be of importance in that respect. On this basis, several reports, (2, 4, 7, 11, 12, 13, 16) have appeared in the literature mentioning the use of vitamin supplements, particularly thiamine chloride, pyridoxine, and nicotinic acid. Jenkinson and Brown (8) have commented on the possible value of amphetamine and *d*-desoxyephedrine. On the other hand, Holmes (6) has demonstrated that serum cholesterol level roughly parallel the development of radiation sickness, and that those patients in whom symptoms develop during the course of irradiation therapy show a fall in the cholesterol level.

Wallace (17) reported ileal studies on a series of patients receiving x-ray therapy over the pelvis and described changes occurring in the small bowel which simulate those of vitamin deficiency. It is interesting to note that he called attention to segmentation of the barium stream, diminution of intestinal motility, and narrowing of the lumen, as well as flattening of the mucosal pattern of the bowel. These observations, coupled with the well known abdominal cramps and tenesmus, strongly suggest that the immediate cause of the nausea, diarrhea, and abdominal pain may be intestinal and sphincter spasm. With this possibility in mind, we theorized that adequate antispasmodic therapy should provide at least symptomatic relief.

## CASES AND TREATMENT

Sixty-five patients receiving intensive x-ray therapy are included in this preliminary series. There was no attempt at

<sup>1</sup> From the Department of Radiology, Duke University School of Medicine and Duke Hospital, Durham, N. C. Accepted for publication in April 1946.



selection of patients, except that those whose symptoms could be "cured" by smelling aromatic spirits of ammonia or other such medication were excluded.

Patients with carcinoma of the cervix were treated with 200-kv x-rays through six external ports, with the addition of intravaginal therapy in a few instances. Those with carcinoma of the colon (all of them rectal lesions) received 400-kv therapy through one anterior and two posterior ports over the involved area, except in case 31, in which radiation was given over the liver for metastasis. For Marie-Strumpell arthritis, 140-kv therapy was used, directed to three spinal and sacroiliac ports. Carcinoma of the breast was treated through one anterior and one posterior port in the axillary regions, with 200-kv therapy. Patients with Hodgkin's disease, lymphosarcoma, undifferentiated carcinoma, etc., received appropriate therapy over the indicated areas with 140- or 200-kv x-rays.

The antispasmodic drug, trasantine (75 mg per tablet), was used initially on 26 patients, with a dosage range from 225 to 1,000 mg per day in divided doses. Thirty-two patients were then treated with trasantine-phenobarbital in doses of 1 or 2 tablets three times a day. Inasmuch as a trasantine-phenobarbital tablet contains 20 mg of trasantine plus 20 mg of phenobarbital, and since a trasantine tablet alone contains 75 mg of the drug, it was thought that nausea and diarrhea might be controlled even more effectively if additional antispasmodic therapy were provided along with the phenobarbital. A small group of patients, therefore, complaining principally of those symptoms were treated with trasantine-phenobarbital, 1 tablet three times a day, plus trasantine in doses of 1 to 3 tablets (75 mg each) three or four times a day. Results in this small series of 7 patients were gratifying.

This form of medication was selected because tablets are easy for most people to take, and the necessity of parenteral therapy is eliminated. Trasantine is non-

habit-forming, and with the amount of phenobarbital contained in trasantine-phenobarbital tablets, the danger of barbiturate habituation is reduced to a minimum. Trasantine is an effective intestinal antispasmodic as shown by a number of workers (18). It has all of the desirable actions of both atropine and papaverine but is essentially devoid of the undesirable side-effects of the former drug on the heart, pupil, accommodation, and the salivary glands (3, 9, 15).

#### DISCUSSION

As shown in the accompanying table, 6 patients failed to gain relief from the use of either trasantine or trasantine-phenobarbital. Two of these had carcinoma of the cervix in terminal stages. One had recently been operated upon for carcinoma of the rectum and an ileostomy had been performed. In 3 patients who failed to respond to trasantine, diarrhea was also unrelieved by large doses of tincture of opium.

Five patients either stopped taking the drug after symptoms were relieved or consumed their entire supply and went for a time without obtaining more. Each of these experienced a return of previous symptoms, which were again relieved upon resuming trasantine medication.

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In those patients who exhibited considerable apprehension, the use of trasantine-phenobarbital was of considerable value, in accord with the well recognized fact that

TABLE I EFFECT OF TRASENTINE AND TRASENTINE-PHENOBARBITAL IN RADIATION SICKNESS

Diagnosis	Symptoms	Treatment and Dose	Relief
1 Carcinoma Cervix	Pain ++ Diarrhea +	T 3 X 4	+++ +++
2 Carcinoma Cervix	Diarrhea +	T 2 X 3	+++
3 Carcinoma Esophagus	Nausea ++	T 2 X 3	+++
4 Carcinoma Cervix	Diarrhea +++	T 2 X 4	+++
5 Carcinoma Cervix	Pain ++	T 2 X 3	+++
6 Carcinoma Cervix	Diarrhea +++	T 3 X 3	0
7 Carcinoma Cervix	Nausea ++	T 2 X 3	+++
8 Carcinoma Cervix	Diarrhea +++	T 3 X 3	+++
9 Carcinoma Cervix	Nausea ++ Diarrhea ++	T 2 X 3	+++ +++
10 Carcinoma Cervix	Nausea +	T 1 X 3	+++
11 Carcinoma Cervix	Pain ++ Nausea ++	T 1 X 4	++ +++
12 Carcinoma Cervix	Nausea ++ Diarrhea +	T 1 X 3	+++ +++
13 Carcinoma Cervix	Nausea ++ Diarrhea +++	T 2 X 3	+ 0
14 Carcinoma Cervix	Nausea ++ Diarrhea +	T 3 X 3	++ +++
15 Carcinoma Cervix	Nausea ++ Diarrhea ++	T 3 X 3	+++ +++
16 Carcinoma Cervix	Nausea ++ Diarrhea +	T 3 X 3	++ ++
17 Carcinoma Cervix	Nausea ++ Diarrhea ++	T 3 X 3	+++ +
18 Carcinoma Cervix	Nausea ++ Diarrhea ++	T 3 X 3	+++ +++
19 Carcinoma Cervix	Diarrhea ++	T 3 X 4	+++
20 Carcinoma Cervix	Pain ++ Diarrhea ++	T 3 X 4	+++ +++
21 Carcinoma Cervix	Diarrhea ++	T 3 X 4	+++
22 Carcinoma Cervix	Nausea ++	T 2 X 3	++
23 Carcinoma Cervix	Nausea ++ Diarrhea ++	T 3 X 3	++ +
24 Carcinoma Rectum	Diarrhea +++	T 3 X 4	0
25 Carcinoma Cervix	Diarrhea ++	T 2 X 4	+++
26 Carcinoma Cervix	Nausea ++ Diarrhea ++	T 2 X 4	++ ++
27 Carcinoma Cervix	Nausea ++	TP 1 X 4	+++
28 Carcinoma Colon	Nausea +++	TP 2 X 3	++
29 Carcinoma Cervix	Nausea ++ Pain ++	TP 2 X 3	+++ ++
30 Marie-Strümpell Arthritis	Nausea ++	TP 1 X 4	+++
31 Carcinoma Rectum	Nausea +++	TP 2 X 3	+++
32 Marie Strümpell Arthritis	Nausea ++	TP 2 X 3	0
33 Carcinoma Cervix	Nausea ++	TP 2 X 3	+++

TABLE I EFFECT OF TRASENTINE AND TRASENTINE-PHENOBARBITOL IN RADIATION SICKNESS (Continued)

	Diagnosis	Symptoms	Treatment and Dose	Relief
34	Carcinoma Breast	Nausea ++	TP 2 × 3	+++
35	Carcinoma Cervix	Nausea +	TP 2 × 3	+++
36	Carcinoma Cervix	Nausea +++	TP 2 × 3	+++
37	Carcinoma Cervix	Nausea ++ Diarrhea +	TP 2 × 3	+++ +++
38	Carcinoma Cervix	Nausea ++	TP 2 × 3	0
39	Carcinoma Cervix	Nausea ++ Diarrhea +	TP 2 × 3	+ +
40	Carcinoma Cervix	Nausea ++ Diarrhea ++	TP 2 × 3	++ ++
41	Lymphosarcoma	Nausea ++	TP 2 × 3	+++
42	Carcinoma Stomach	Nausea +++	TP 2 × 3	++
43	Carcinoma Rectum	Nausea +	TP 2 × 3	++
44	Carcinoma Ovary	Nausea ++ "Nervousness" ++	TP 2 × 3	+++ +++
45	Hodgkin's Disease	Nausea ++	TP 2 × 3	+++
46	Carcinoma Cervix	Nausea ++	TP 2 × 3	+++
47	Carcinoma Cervix	Nausea ++	TP 2 × 3	++
48	Carcinoma Rectum	Nausea +++	TP 2 × 3	+++
49	Carcinoma Cervix	Nausea +	TP 1 × 3	++
50	Carcinoma Breast	Nausea ++	TP 1 × 4	+
51	Hodgkin's Disease	Nausea ++	TP 1 × 4	+++
52	Undiffer Carcinoma	Nausea +	TP 1 × 4	+++
53	Carcinoma Cervix	Diarrhea ++	TP 1 × 4	0
54	Carcinoma Cervix	Nausea ++ Diarrhea ++	TP 1 × 4	+++ +++
55	Carcinoma Cervix	Nausea +	TP 1 × 3	+++
56	Marie-Strümpell Arthritis	Nausea +	TP 1 × 3	+++
57	Hodgkin's Disease	Nausea ++	TP 1 × 4	+++
58	Carcinoma Cervix	Nausea +++	TP 1 × 4	+++
59	Carcinoma Cervix	Nausea + Diarrhea ++	TP 1 × 4, T2 × 3	+ +++
60	Carcinoma Cervix	Nausea +++ Diarrhea ++	TP 1 × 3, T2 × 3	+++ +++
61	Carcinoma Cervix	Nausea ++ Diarrhea ++	TP 1 × 3, T3 × 3	++ ++
62	Carcinoma Cervix	Nausea + Diarrhea ++	TP 2 × 3, T1 × 3	+++ +++
63	Carcinoma Cervix	Pain + Diarrhea ++	TP 1 × 4, T2 × 4	+++ +++
64	Carcinoma Cervix	Nausea ++ Diarrhea +	TP 1 × 3, T3 × 4	+++ +++
65	Carcinoma Cervix	Nausea +++ Diarrhea +++	TP 1 × 3, T2 × 3	+++ 0

T Trasentine TP Trasentine-phenobarbital compound 1 × 4 One tablet four times a day 2 × 3  
 Two tablets three times a day, etc + mild or slight ++ moderate +++ severe (or complete relief)  
 0 No relief

a sedative is of benefit in some cases of radiation sickness. The combination of trasentine and phenobarbital in a single tablet is of advantage, also, in that it eliminates the necessity of two different medications.

We do not as yet know what, if any, influence trasentine may have upon the altered physiology of the intestinal tract, but studies of this problem are contemplated.

#### SUMMARY AND CONCLUSIONS

From data obtained up to the present time, we believe that trasentine and trasentine-phenobarbital are valuable adjuncts in the treatment of radiation sickness. No toxic symptoms were noted among the patients thus treated even though some received almost 1,000 mg of trasentine per day (three 75 mg tablets 4 times a day).

Trasentine seems to depress the appetite to some degree, but this factor is obviously difficult to evaluate in the type of patient under consideration. Conversely, some patients volunteered that their appetites were better after receiving trasentine. This may well be due to the relief of such disturbing symptoms as nausea and diarrhea.

**NOTE.** The trasentine and trasentine-phenobarbital used in this study were supplied through the courtesy of Ciba Pharmaceutical Products, Inc., Summit, N J.

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# A Simple, Accurate Fluoroscopic Method of Foreign Body Localization<sup>1</sup>

LT COL H W JAMISON, M C, A U S

THE METHOD OF foreign body localization herein described has proved in practice to be highly accurate and rapidly and easily accomplished. It has the added advantage of requiring no special apparatus. It is applicable to any fluoroscopic unit having some provision for fixing the distance from fluoroscopic screen to table top.

The screen is moved cranially until the center of the image of the skin marker coincides with the edge of the screen. Then, with a soft wax pencil, a mark is made on the screen at the center of the projected foreign body image. The screen is next shifted caudally until the shadow of the skin marker coincides with the opposite margin of the

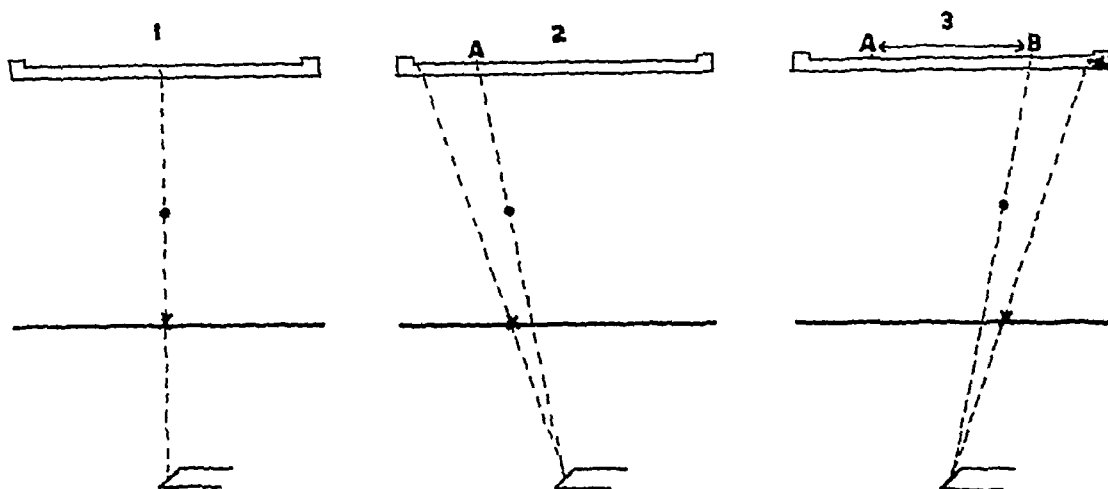


Fig 1 Images of foreign body and skin marker superimposed at center of fluoroscopic screen

Fig 2 Fluoroscopic screen shifted cranially until the image of the skin marker coincides with the margin of the screen. The position of the foreign body image is indicated on the screen by A

Fig 3 Fluoroscopic screen shifted caudally until the image of the skin marker coincides with the opposite margin of the screen. The new position of the foreign body image is indicated on the screen by B. The depth of foreign body (from skin marker) is inversely proportional to distance AB

The patient is placed on the fluoroscopic table. The fluoroscopic screen is fixed at a predetermined distance from the table top, and its illumination is limited to a narrow beam centered directly over the foreign body to be localized. A lead cross or other metallic marker is affixed by adhesive tape to the patient's skin on the dependent side in such a position that the projected images of the foreign body and cross are superimposed. The fluoroscopic beam is then adjusted to a narrow slit parallel to the long axis of the body, extending across the full

screen. A second mark is made with the wax pencil at the new position of the foreign body image. The distance between wax marks on the fluoroscopic screen is then measured, and, by reference to a calibration chart, the depth of the foreign body can be read off directly. The point of attachment of the lead marker is indicated on the skin by wax pencil at the time the marker is removed. The position of the foreign body can then be reported as being "— cm deep to the mark on the skin."

Localization depends on the relative shift of the projected foreign body image

<sup>1</sup> Accepted for publication in November 1945.

on the fluoroscopic screen as compared with that of the lead skin marker, which, being attached to the dependent portion of the patient's body, is at table-top level. By using the diameter of the fluoroscopic screen as a measure, the skin marker image shift is kept constant. The screen-table top and focal-screen distances are also fixed. Thus, the only variable factor is the shift of the foreign body image, which, in turn, is proportional to depth of the foreign body in the tissues.

A calibration chart indicating depth of foreign body in relation to foreign body image shift can be constructed mathematically, given focal-table top, focal-foreign body, and focal-screen distances. More

simply, calibration can be made by using a phantom, such as a discarded film box top, to which appropriate lead numbers are fixed at 1 cm intervals from fluoroscopic table.

This method of localization has several advantages. It is based on triangulation using large dimensional relations and hence is highly accurate; it requires no special apparatus other than some method for fixing table top-fluoroscopic screen distance and is therefore applicable to almost all fluoroscopic units; it requires only a few seconds for its accomplishment.

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# Medical and Hospital Insurance Problems<sup>1</sup>

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DOCTORS WHO discuss subjects like the one assigned to me must be careful not to use the words "socialism" or "socialistic" as epithets. If by the philosophy of socialism we mean that the strong should help to bear the burdens of the weak, doctors are the oldest and almost the only real socialists. Since the dawn of civilization, long before Karl Marx expounded his doctrines, they have adjusted their fees to the ability of their patients to pay in an effort to see that the rich shall meet the expense of supplying medical service to the poor. As a class, they believe in the general principles of insurance, that thrift is a virtue, and that the wise will budget against heavy unforeseen expenditures. I have asked many of my own colleagues how they would like to have their county medical society practice as a guild, receiving two dollars per month for each man, woman, and child in the county, this money being distributed according to the ability, energy, and popularity of the members. The great majority of those questioned appeared to believe that under an *ideal* administration of such a plan, with overhead expense cut to a minimum, with no duplication of equipment or labor, and with the time-consuming amenities incidental to competitive private practice abolished, they would find their incomes greater, their work easier, their responsibilities lighter, and their leisure time longer. Doctors do not object to having their fees paid. They support workmen's compensation laws in the various states in spite of the fact that these laws provide professional services under a compulsory insurance plan.

Why, then, do doctors invariably view with suspicion any proposal to supply medical services through such agencies as

the Blue Cross, voluntary medical insurance plans, or compulsory insurance plans as proposed in the Wagner-Murray-Dingell bill. I think the answer is simple. It is not because these proposals are socialistic. What is feared is not socialization but regimentation. We fear, and we have good reason to fear, the introduction of a third party between ourselves and our patients. This third party would have the power, because he would hold the purse-strings, to say what patients should be treated, how long, and in what manner, though his only qualification for his job might be that he is a good, faithful wheel horse of his party. We have reason to fear regimentation because of our experience with the care of the indigent sick during the depression. When social workers or overseers of the poor had to contend not only with social problems, but also those which could be solved only by professionals, the whole administration of medical relief was unsatisfactory to everyone concerned. Some progress in efficiency, economy, and the promotion of the welfare of the patients began to be made only when social and medical problems were completely divorced, the former being solved by trained social workers, the latter by medical men.

In its opposition to regimentation and political domination, three courses lie open to the organized medical profession. We might listen to those, some of them sitting in the seats of the mighty, who believe that every proposal for change should be opposed. If the entire membership should stand with a united front, such opposition might be successful, but it is apparent that unanimity of opinion among all the members of a profession like ours is impossible, although we can expect, and can demand, unanimous action based upon the will of

<sup>1</sup> Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1915.

the majority But there are many doctors who believe changes in our methods of furnishing medical care are necessary and desirable, there are many more who are convinced that changes are inevitable and that it is our function to see that they are wise changes The second course of action is to abandon completely those principles to which all honorable doctors subscribe, and to the support of which they dedicate their lives, and supinely accept all proposals, in spite of the fact that we know some of them would turn back the practice of medicine to medieval times One course would result in a program being forced upon us which would eventually reduce the standards of medical practice to the level of those in Central Europe The other would result in a hopeless division within our own ranks

Organized American physicians must follow a third course, approaching their task in a spirit of conciliation and compromise In spite of what our so-called spokesmen say, those who deal directly with patients know that the problem of supplying adequate medical service to the underprivileged does exist They know that many men and women fail to get needed medical service because "to beg they are ashamed" This is our problem and that of the people Even now, it is not too late for us to solve it, if we choose, by promoting hospital insurance, insurance against catastrophic illness, and by controlled experimentation with plans for prepaid medical service to members of the low-income group by medical societies We must differentiate sharply between mass medical service under political domination, a thing we all hate and fear, and mass medical service administered and controlled by medical organizations The physician must remain "the master in the house of medicine" He must be kept free from political control If these things can be done, and I think they can, we have no more reason to fear changes in methods of practice than we have cause to regret the economic changes we have already seen in our own professional lifetime

The problems of radiologists, as they are related to hospital and medical insurance, are more complex than those of the general medical profession The nature of their calling compels radiologists not only to practice an art, but also to conduct a business X-ray apparatus is expensive, and so much capital is required that many a young radiologist either prefers or is driven by necessity to accept a salaried position instead of establishing his own practice Overhead is high If only half our patients paid us, or if our average fees were reduced one-half without an increase in volume, most of us would soon be bankrupt The American Hospital Association, the Blue Cross, and most of its member hospitals appear to be determined to include x-ray service as an integral part of hospitalization in spite of the opposition of the organized medical profession They want to be allowed to buy professional x-ray service at wholesale and to sell it at retail Finally, many doctors, perhaps a majority of them, would like x-ray examinations to be free to their patients and paid for by insurance or by taxation, as Wassermann tests are paid for now The most bitter opponents of national compulsory health insurance bills, including the president of the A M A in 1943, seem to agree that the government can properly establish "diagnostic centers" wherever they are needed Those who are thoughtful and observant are forced to the conclusion that radiologists are apt to follow the pathologists to the altar as a sacrifice to "conciliation and compromise"

On the other hand, we are not altogether helpless We are a small, compact group knit closely together in associations, and we have the American College of Radiology to protect our economic interests We are trained to observe We have seen the fate of our colleagues, the pathologists, we can see what may be in store for us We are an essential group, the hospitals and the medical profession need us, our cooperation, and support, more than we need them While the great majority of radiologists would prefer to continue to practice



as specialists, they need not do so. If they should be abandoned by their professional brethren, many radiologists could do fairly well in gastroenterology or internal medicine, most of them could treat fractures adequately, and many could qualify in dermatology and other specialties.

In our dealings with hospitals and with hospital insurance plans, it is vitally important that we continue to insist upon a sharp differentiation between hospital services and professional services. There are three compromises which we can safely accept:

1. Radiology can be excluded from Blue Cross and included in the medical service plan offered to Blue Cross subscribers. This is both the most logical and desirable compromise.

2. The medical service plan can issue a supplemental contract paying cash benefits for radiology, pathology, and anesthesiology, to be sold with the Blue Cross contract to subscribers.

3. Blue Cross can itself pay cash benefits for medical services, thus actually separating them from hospital care. This compromise was adopted in the states of Washington and Iowa.

At the 1943 meeting of the Iowa State Medical Society, a reference committee was appointed to study the proposal of the Blue Cross to expand its benefits to include x-rays, anesthesia, and certain other professional services *as a part of hospital service*. The hearings of this committee were attended by representatives of the Iowa X-Ray Club and Mr. Mac Cahal of the College of Radiology. The committee recommended that services which, legally and ethically, can be rendered only by licensed physicians be excluded from the hospital service plan. The recommendation was adopted by the House of Delegates. Late in 1943, however, the Executive Council of the State Society reversed the decision of the House of Delegates and approved the Blue Cross proposal, going so far as to say that fees for such professional services should be paid by the insurance company to the hospitals as agents of the doctors.

Incidentally, the transcript of the minutes of this meeting shows very clearly that many members of the Executive Council failed to grasp the implications of the proposal.

At its 1944 meeting, the Iowa X-Ray Club appointed a committee to meet with a committee from the directors of the Blue Cross to try to arrive at a satisfactory compromise. These men were very sympathetic to our position which, briefly, was that the insurance company could properly undertake to furnish hospital service, but not professional service over which it had no control. We did not, however, object to the insurance company undertaking to pay for such professional services, provided that they were clearly separated from hospital services. But the Board of Directors refused to accept the recommendation of its own committee. Shortly afterward the secretary of the Iowa X-Ray Club wrote a letter to members of the Executive Council of the medical society and to some of the directors of the Blue Cross, in which he said that, in spite of our efforts at compromise, the Blue Cross was apparently determined to practise medicine, and that since we have a pretty good medical practice act in Iowa, perhaps the quickest, cheapest, and easiest way of settling the controversy would be for the Iowa X-Ray Club, through one of its members, supported and financed by the medical society, to file a suit against the Blue Cross or one of its member hospitals, asking for an injunction to restrain the company or its member hospitals from practising medicine. This was not a threat, it was just a suggestion. At the next meeting of the Directors of the Blue Cross, they adopted a new contract, which from our standpoint is satisfactory because it contains these two paragraphs:

"The Service Corporation further agrees to make the following credit allowance toward the physician's fee for the professional medical services within the limits as outlined below:

"Professional medical services as used in this contract refers to services which legally and ethically can be performed only by a licensed physician but for which the Service Corporation agrees to pay. The Service Corporation cannot provide, and does

the majority. But there are many doctors who believe changes in our methods of furnishing medical care are necessary and desirable, there are many more who are convinced that changes are inevitable and that it is our function to see that they are wise changes. The second course of action is to abandon completely those principles to which all honorable doctors subscribe, and to the support of which they dedicate their lives, and supinely accept all proposals, in spite of the fact that we know some of them would turn back the practice of medicine to medieval times. One course would result in a program being forced upon us which would eventually reduce the standards of medical practice to the level of those in Central Europe. The other would result in a hopeless division within our own ranks.

Organized American physicians must follow a third course, approaching their task in a spirit of conciliation and compromise. In spite of what our so-called spokesmen say, those who deal directly with patients know that the problem of supplying adequate medical service to the underprivileged does exist. They know that many men and women fail to get needed medical service because "to beg they are ashamed." This is our problem and that of the people. Even now, it is not too late for us to solve it, if we choose, by promoting hospital insurance, insurance against catastrophic illness, and by controlled experimentation with plans for prepaid medical service to members of the low-income group by medical societies. We must differentiate sharply between mass medical service under political domination, a thing we all hate and fear, and mass medical service administered and controlled by medical organizations. The physician must remain "the master in the house of medicine." He must be kept free from political control. If these things can be done, and I think they can, we have no more reason to fear changes in methods of practice than we have cause to regret the economic changes we have already seen in our own professional lifetime.

The problems of radiologists, as they are related to hospital and medical insurance, are more complex than those of the general medical profession. The nature of their calling compels radiologists not only to practice an art, but also to conduct a business. X-ray apparatus is expensive, and so much capital is required that many a young radiologist either prefers or is driven by necessity to accept a salaried position instead of establishing his own practice. Overhead is high. If only half our patients paid us, or if our average fees were reduced one-half without an increase in volume, most of us would soon be bankrupt. The American Hospital Association, the Blue Cross, and most of its member hospitals appear to be determined to include x-ray service as an integral part of hospitalization in spite of the opposition of the organized medical profession. They want to be allowed to buy professional x-ray service at wholesale and to sell it at retail. Finally, many doctors, perhaps a majority of them, would like x-ray examinations to be free to their patients and paid for by insurance or by taxation, as Wassermann tests are paid for now. The most bitter opponents of national compulsory health insurance bills, including the president of the A. M. A. in 1943, seem to agree that the government can properly establish "diagnostic centers" wherever they are needed. Those who are thoughtful and observant are forced to the conclusion that radiologists are apt to follow the pathologists to the altar as a sacrifice to "conciliation and compromise."

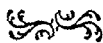
On the other hand, we are not altogether helpless. We are a small, compact group, knit closely together in associations, and we have the American College of Radiology to protect our economic interests. We are trained to observe. We have seen the fate of our colleagues, the pathologists, we can see what may be in store for us. We are an essential group, the hospitals and the medical profession need us, our cooperation, and support, more than we need them. While the great majority of radiologists would prefer to continue to practice

literally, between life and death. It is comforting to be able to share the heavy burdens of responsibility that we all must carry. Partnerships and similar combinations also have the tremendous advantage of utilizing the skill, training, strength, endurance, and enthusiasm of youth immediately and of avoiding a long, difficult, discouraging struggle to build up a practice.

Finally, the high cost of sickness is largely responsible for much of the present agitation for radical innovations in our system of medical care. Perhaps we should seriously consider the possibility of reducing the cost of x-ray diagnosis by any means consistent with good service. In the past year a committee of the Iowa X-Ray Club has made a study of the cost of various x-ray diagnostic procedures, including overhead and depreciation at various levels of volume, and is making estimates of the degree to which fees could be reduced without reduction of net income, if collection expense were eliminated and if volume were

multiplied one and one-half, two, or three times. The committee was appointed because most of us would prefer a fee-for-service basis of compensation to a salary, because reduction of fees might well be the best way to meet the threat of tax-supported "diagnostic centers," and also because even the Wagner-Murray-Dingell bill provides for payment on a fee basis. The committee limited its investigation to learning the cost per examination and per film. These costs, and especially their dependence on volume, are shown graphically in Figure 1. If the Wagner-Murray-Dingell bill or some modification of it should be passed, it would be to our advantage to have some knowledge of average costs and possible reductions of fees. Obviously, they would not be the same in all communities, and similar investigations and estimates by state and national radiological societies might be useful.

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Cedar Rapids, Iowa



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What else can we do to ensure that radiology shall continue to endure as a specialty? Fortunately, we are well aware of the dangers that threaten it, and we can face them unitedly, realistically, and with some confidence in the weapons ready to our hands. Radiologists can properly use any legitimate methods of enhancing their

in the smaller cities can all spend a minute or two talking to each of their patients and showing some interest in their welfare. Those who work in great metropolitan centers, if they are really consultants, might well do the same thing, even though it might require them to make rounds.

Radiologists who conduct their own practices and work in hospitals in competition with themselves have a stronger position in their relationship to hospitals and

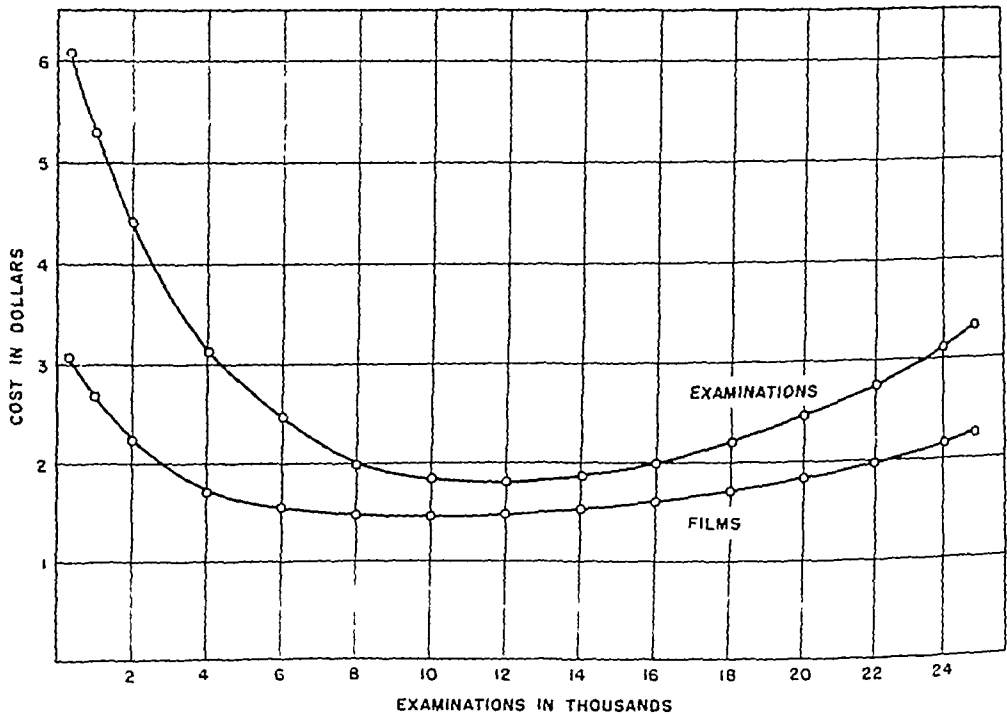


Fig 1 Cost per examination and per film in Iowa plotted against volume.

reputations among the public. We often receive patients who have spent some time in great metropolitan hospitals. These patients all know the names of their attending physicians or the surgeons who operated upon them. None of them knows the name of the roentgenologist who examined him and probably made the diagnosis. Practically all of them believe that "a girl" made the x-ray examinations. Forty per cent of the qualified radiologists of the United States (50 per cent if the four largest cities are excluded) practise in cities of less than 100,000 population. The radiologists

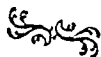
insurance companies than those on salaries. I suggest that we should plan *now* to absorb in partnerships as many young radiologists as we can on their release from the Armed Services. This will not only lessen the number of radiologists without much capital who might be tempted to accept salaried positions for the sake of security, it will also tend to reduce competition, with its attendant wasteful duplication of equipment and overhead. Modern radiology now covers such a broad field that no individual can hope to learn it all. Important decisions must be made, some of them,

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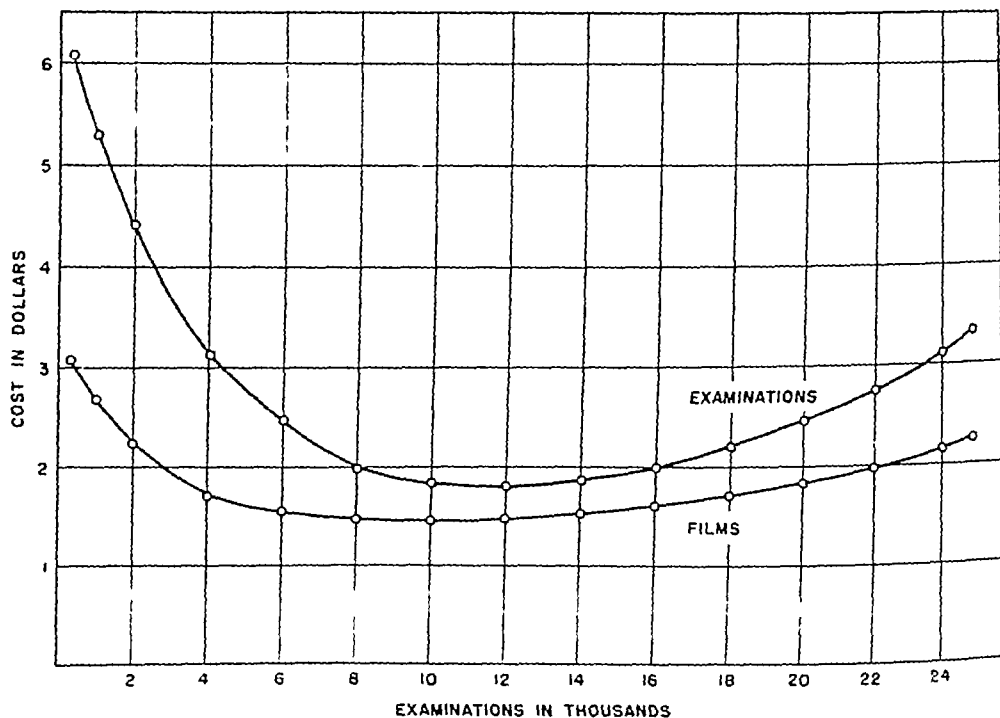


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which is used to designate a defect in the neural arch without anterior slipping of the vertebral body. While the word describes the condition fairly well, it carries the implication that the vertebra *will* slip. Either spondyloschisis (from the Greek words for vertebra and fissure) or spondylolysis (from the Greek for vertebra and dissolution) is a better term for a neural arch defect when no slipping has occurred. Or, if one objects to the rather bookish Greek words, he may employ the English description instead.

This example has a special application in reporting the facts as observed on the x-ray film and differentiating between these and the opinions or implications which they are believed to justify. The radiologist should report what he sees on the film, and then draw a logical conclusion, if that is clear, nothing further need be written. On the other hand, if it is not clear or if his opinion is at variance with the shadows described, he should state this unequivocally. In this way, implied meanings are unveiled and clarified. The word "prespondylolisthesis" implies, as well as describes, and to the uninformed (and/or the insurance company) the implication may be that, because there is the possibility of a slip, there will inevitably be a slip. The term is indeed a dangerous one, and the sooner it is discarded the better.

Other examples of unjustifiable implication are to be found in reports of chest examinations. The most frequent of these is the unqualified interpretation of certain densities in the lungs as "tuberculosis in

the apex." This implies that the roentgenogram is able to furnish enough differential evidence to distinguish the exact cause of the pulmonary shadows. Actually a specific bacterial diagnosis is not possible on the basis of the roentgen findings alone, though the statistical chances are high that densities found in a particular location and of a particular character are tuberculous.

Another regrettable practice is the description of masses or densities as "the size of a walnut," or a grapefruit, or some other more or less familiar object. If the radiologist would have his confreres respect his words, he should discard such unprecise estimates and accurately measure and report dimensions in centimeters or inches (and in the use of these units he should be consistent). This also holds for fractures. When separation of fragments is being considered, exact measurements are of great help. When displacements of fragments in the shaft of a bone are involved, the percentage of offset is even more useful, since here the relative displacement is more important than the absolute.

Pressure is frequently brought to bear upon the radiologist to turn his roentgenographic findings into a clinical diagnosis, as "mucous colitis" or "chronic appendicitis." To interpret such a roentgenographic finding as slight irritability of the colon as "mucous colitis," or slight stasis of barium in the appendix as "chronic appendicitis," endangers the scientific approach that it is the radiologist's privilege and obligation to impart to medicine.

SYDNEY F. THOMAS, M.D.

# EDITORIAL

## To the Members of the Radiological Society of North America

The Thirty-second Annual Meeting of the Radiological Society of North America will be held at the Palmer House in Chicago, the first week in December. Sessions begin on Monday, December 2nd, and extend through Friday, December 6th.

Since this is the first full-scale meeting that the Society has held since 1941, it is expected that there will be a large attendance. The scientific exhibits and refresher courses, and the program (which appears elsewhere in this issue) will, I believe, repay everyone who attends. The various members of the Program Committee have worked untiringly to secure a series of excellent presentations, and the Committees in charge of the refresher courses and the exhibits have been no less diligent in the preparation of these features.

It is apparent to every radiologist that

the successful harnessing of atomic energy opens up vast fields of new knowledge. Artificial radioactivity and the use of various radioactive isotopes in diagnostic and therapeutic medicine will be of the greatest importance in the future, and these subjects are of particular interest to radiologists, since their basic training makes them peculiarly fitted to employ these methods intelligently.

Because of this, the Program Committee has devoted the entire opening day of the Annual Meeting to the Plutonium Project. Nine papers will be presented by some of the most distinguished scientists in America. The entire Society owes a debt of gratitude to these men who have willingly and cheerfully undertaken the project.

LOWELL S GOIN, M.D.  
*President*

## The Radiologist's Report

The radiologist's share in shaping the type of medicine practised in a community, clinic, or hospital is considerable. His report, in many cases, furnishes the final evidence for diagnosis, upon which treatment is based, and it may be the deciding factor in the settlement of a claim for compensation or insurance. It behooves him, therefore, to use a language which is correct and yet understandable without being stilted, to be concise but explicit. The accuracy of his words and descriptions and his regard for the finer shades of meaning will be taken as a measure of his professional ability. In no other specialty is the slightest misuse of a word or phrase so likely to re-

flect upon the writer. The radiologist, therefore, should clean his verbal house.

Examples come readily to mind. Many radiologists, for instance, speak of "getting accommodated" or "dilated" in the fluoroscopic room, whereas what actually takes place is the adaptation of the retina to the dark. It is the pupil that is dilated and the lens that is accommodated, the former reacting almost instantaneously to changes in the amount of light, the latter changing its thickness so as to keep the image in focus on the retina.

Another type of misuse is exemplified by the term "prespondylosthesis" an unfortunate mixture of Latin and Greek.



pose characterized his life. He was unswervingly devoted to his home and family and after these came his professional career, which he followed with fixed and definite purpose.

Dr Bader was graduated from the University of Cincinnati College of Medicine in 1913. He enlisted in the British Army and later transferred to the United States Army in World War I. During his professional life, he held many important positions. He had been radiologist at Bethesda and Deaconess Hospitals in Cincinnati and at St Elizabeth Hospital in Covington, Kentucky. At the time of his death, he was radiologist at Christ Hospital in Cincinnati. He was also on the consulting staff at Children's Hospital. For many years he had been Assistant Professor of Radiology at the University of Cincinnati College of Medicine. Always active in organized medicine, he had served the Cincinnati Academy of Medicine and the Ohio State Radiological Society as secretary. He had been a member of many important committees of

the local and state medical societies. In 1937, he was first vice-president of the Radiological Society of North America and, prior to that, he had been Counselor for Southern Ohio for many years. At the time of his death, he was the second vice-president of the American Roentgen-Ray Society and Counselor of the American College of Radiology for Southern Ohio. He is survived by his wife, Dorothy Adams Bader, a daughter, Harriet Bader Wilks, who is a registered nurse, and a son, Robert, who is a medical student.

Dr Bader had an unusually wide circle of friends and acquaintances in the Cincinnati area. He was known for his honesty and integrity and had built an enviable reputation as a radiologist. In his life he reflected only credit on the practice of medicine in general and on the specialty of radiology in particular. The Radiological Society of North America has lost a valuable member and his associates a devoted friend.

HAROLD G. REINEKE, M.D.

## Clark Anson Wilcox, M.D.

1890-1946

Dr Clark A. Wilcox, of Wichita Falls, Texas, a member of the Radiological Society of North America since 1920, died on April 4, 1946, of aplastic anemia.

Dr Wilcox was born in Scottsville, N. Y., in 1890, was graduated from the University of Michigan, and received his degree in medicine from the New York Homeopathic College and Flower Hospital. In 1917 he was commissioned a first lieutenant in the Medical Reserve Corps of the Army. After several years in the Reserve, he accepted the commission of captain in the Medical Corps of the

U. S. Army, later resigning to enter civilian practice in Wichita Falls. He was made a major in the Reserve Corps in 1924 and was promoted to lieutenant colonel in 1931. From 1923 until his death Dr Wilcox was radiologist with the Wichita Falls Clinic and Clinic-Hospital.

Dr Wilcox was a diplomate of the American Board of Radiology, a fellow of the American College of Radiology, and a fellow of the American College of Physicians. He is survived by his wife, Ruth Gracelon Wilcox, and two daughters, Miss Allene Wilcox and Mrs. J. R. Kolb, Jr.

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## IN MEMORIAM



*Photo by J. Anthony Hill*

### Ellis R. Bader, M.D.

1888-1946

On June 16, 1946, death came to Ellis Robert Bader of Cincinnati at the age of fifty-eight. For twenty-five years he had been associated with the late Dr. William M. Doughty, whose death preceded his by exactly twenty-six months. For over a year and a half Dr. Bader had suffered from chronic mye-

logenous leukemia, but the immediate cause of his passing was a cerebral thrombosis. He was well aware of what was ahead of him during these twenty months and he faced the inevitable with remarkable courage.

To those who knew Dr. Bader, certainty of pur-

- 5 X-Ray Signs of Altered Alimentary Function Following Autonomic Blockade with Tetra Ethyl Ammonia JOHN F HOLT, M D, RICHARD H LYONS, M D, GORDON K MOE, M D, AND FRED J HODGES, M D, Ann Arbor, Mich

### THERAPY SESSION 2 30 P M

#### SYMPOSIUM ON CARCINOMA OF THE UTERINE FUNDUS AND CERVIX

Chairman Edw C Ernst, M D  
St. Louis, Mo

- 1 Pathological Aspects, ROBERT MOORE, M D, Dean and Professor of Pathology, Washington University, St Louis, Mo
- 2 Clinical Phases of the Cervical Cancer Problem, A N ARNESON, M D, Barnard Hospital, St Louis, Mo
- 3 Some Aspects of Radium Therapy, H H BOWING, M D, Mayo Clinic, Rochester, Minn
- 4 Transvaginal Radiation Methods, JUAN A DEL REGATO, Missouri State Cancer Hospital, Columbia, Mo
- 5 The Surgical Aspects of Uterine Carcinoma, JOHN BREWER, M D, Chicago, Ill
- 6 Five Year End-Results in the Treatment of Carcinoma of the Uterine Cervix, EDWARD L JENKINSON, Chicago, Ill

### THE CARMAN LECTURE 8 00 P M.

#### QUALITY OF RADIATION IN THERAPY

ROBERT R NEWELL, M D  
Professor of Radiology, Stanford University  
San Francisco, Calif

Wednesday, December 4

### GENERAL SESSION 10 30 A M

- 1 Filter Value Inherent in Very High Voltage Radiation Therapy Equipment, E DALE TROUT AND Z J ATLER, Chicago, Ill
- 2 Effects of Estradiol Benzoate on Bone Formation and Blood Calcium Levels in the Cockerel and Their Modification by Bleeding, KURT SALOMON, M D, PH D, BEVERLY WESCOTT GABRIO, A B, EDWARD REINHARD, M D, AND RUTH SILBERBERG, M D, St Louis, Mo  
*Discussion*
- 3 Experimental Clostridial Infections in Dogs, ANDREW H DOWDY, M D, Rochester, N Y  
*Discussion* ROBERT P BARDEN, M D, Philadelphia, Penna
- 4 Further Studies on the Relation between Radiation Effects, Cell Viability and Induced Resistance to Malignant Growth IV Effects of Roentgen Rays on Mammary Tumors Autogenous to Inbred Strains of Mice (dbrB and C3H), ANNA GOLDBLDER, D Sc, M U C, New York, N Y  
*Discussion* G FALLA, PH D, New York, N Y

### DIAGNOSTIC SESSION 2 00 P M

- 1 Problems in the Diagnosis of Cancer of the Colon, KENNETH S DAVIS, M D, AND WILLIAM DANIELS, M D, Los Angeles, Calif  
*Discussion*
- 2 Roentgen Ray Diagnosis of Pigmented Villonodular Synovitis and Synovial Sarcoma of the Knee Joint Preliminary Report, RAYMOND W LEWIS, M D, New York, N Y (by invitation)  
*Discussion* JACOB GERSHON-COHEN, M D, Philadelphia, Penna
- 3 The Adult Silent Chest, GEORGE M LANDAU, M D, AND HILDEGARD A SCHORSCH, M D, Chicago, Ill  
*Discussion* EARL E BARTH, M D, Chicago, Ill
- 4 Giant-Cell Tumor of Bone, FRANKLIN B BOGART, M D, Chattanooga, Tenn, AND ALLISON E IMLER, M D, Birmingham, Ala  
*Discussion*
- 5 Appendiceal Coproliths, S F THOMAS, M D, Palo Alto, Calif
- 6 Cardio-Esophageal Relaxation as a Cause of Vomiting in Infants, EDW B D NEUHAUSER, M D, AND WM BERENBERG, Boston, Mass  
*Discussion*

### THERAPY SESSION 2 00 P M

- 1 Giant Follicular Lymphadenopathy (Brill-Symmer's Disease), ERICH M UHLMANN, M D, Chicago, Ill  
*Discussion*
- 2 An Evaluation of Radiation Therapy of Carcinoma of the Skin, CLAYTON H HALE, M D, Syracuse, N Y  
*Discussion*

#### SYMPOSIUM ON THE TREATMENT AND CARE OF ADVANCED CANCER PATIENTS

Chairman H H Murphy, M D  
Victoria, B C

- 3 Introduction, H H MURPHY, M D
- 4 Care of Patients with Pelvic Cancer, WM. E COSTLOW, M D, Los Angeles, Calif
- 5 Care of Patients with Breast Cancer, ARTHUR W ERSKINE, M D, Cedar Rapids, Iowa
- 6 Care of Patients with Mouth and Throat Cancer, GRANT BECKSTRAND, M D, Long Beach, Calif  
*Discussion* (of papers 4, 5, 6) H H MURPHY, M D

Thursday, December 5

### GENERAL SESSION 10 30 A M

- 1 Medical, Biological, and Industrial Applications of Monochromatic Radiography and Microradiography, GEORGE L CLARK, PH D, D Sc, Urbana, Ill (by invitation)  
*Discussion* KENNETH E CORRIGAN, PH D, Detroit, Mich

# RADIOLOGICAL SOCIETY OF NORTH AMERICA

## THIRTY-SECOND ANNUAL MEETING, PALMER HOUSE, CHICAGO DEC 2-DEC 6, 1946

Monday, December 2

### GENERAL SESSION 10 30 A M

#### CALL TO ORDER

LOWELL S GOIN, M D, President  
Los Angeles, Calif

#### ADDRESS OF WELCOME

ROBERT S BERGHOFF, M D  
President of Illinois State Medical Society

#### PRESIDENTIAL ADDRESS

#### RADIOLOGY AND THE FUTURE

LOWELL S GOIN, M D

#### THE PLUTONIUM PROJECT

Chairman. Austin M Brues, M.D

Director, Biology Division, Argonne National Laboratory, and Associate Professor of Medicine, University of Chicago

- 1 Some Biological Effects of Neutrons, RAYMOND E ZIRKLE, Ph D, Director, Institute of Radiology and Biophysics, and Professor of Botany, University of Chicago
- 2 Biological Studies in the Tolerance Range, EGON LORENZ, Ph D, Principal Biophysicist, National Cancer Institute, Bethesda, Md

#### COUNSELLORS' LUNCHEON

### GENERAL SESSION 2 00 P M

#### THE PLUTONIUM PROJECT (Continued)

- 3 An Evaluation of Blood Changes from Radiation Exposure Near the Tolerance Level, LEON O JACOBSON, M D, Assistant Professor of Medicine University of Chicago
- 4 The Metabolism of Fission Products JOSEPH B HAMILTON, M D, Associate Professor of Medical Physics, University of California
- 5 Some Physiological Effects of Radiation, C LADD PROSSER, Ph D, Associate Professor of Physiology University of Illinois
- 6 Effects of Beta Rays on the Whole Animal, JOHN R RAPER, Ph D, Assistant Professor of Botany, University of Chicago

- 7 Histological Changes Following Radiation Exposures, WILLIAM BLOOM, M D, Professor of Anatomy, University of Chicago
- 8 Tumor Production by Radioactive Materials, AUSTIN M BRUES, M D
- 9 Biologic Effects of Pile Radiations, PAUL S. HENSHAW, Ph D, Biologist, Monsanto Chemical Company, Clinton Laboratories Knoxville, Tenn

### MEMBERSHIP DINNER AND EXECUTIVE SESSION 7 00 P M

Tuesday, December 3

### GENERAL SESSION 10 30 A M

- 1 Quantitative Data on the Characteristics of Commercial X-Ray Films and Screens, RUSSELL H. MORGAN, M D, Chicago, Ill  
*Discussion* W EDWARD CHAMBERLAIN, M D, Philadelphia, Penna
- 2 Isotopes in Medical Investigation and Therapy, JOHN H LAWRENCE, M D, Berkeley, Calif
- 3 Deposition of Radioactive Iodine in the Normal and Malfunctioning Thyroid Gland in Children, EDITH H QUIMBY, Sc.D, AND DONOVAN McCUVE M D, New York, N Y
- 4 Application of Radioactive Isotopes to a Study of Radiation Effects in Cells, MARTIN D KAMEN, Ph D, St Louis, Mo  
*Discussion* (of papers 2, 3, 4) W EDWARD CHAMBERLAIN, M D, Philadelphia, Penna

### EXECUTIVE SESSION 2 00 P M

### DIAGNOSTIC SESSION 2 30 P M

- 1 Catheterization of the Heart, Indications, Errors, and Technic, MERRILL C SOSMAN, M D, Boston, Mass
- 2 Catheterization of the Heart, Results, Interpretations, and Value L F DEXTER, M D, Boston, Mass (by invitation)  
*Discussion* (of papers 1 and 2) WENDELL G SCOTT, M D, St Louis, Mo
- 3 Differential Diagnosis of Retrocardiac Shadows, STANLEY S NEMEC, M D, St Louis, Mo (by invitation)  
*Discussion* LEROY SANTE M D, St Louis, Mo
- 4 Calcification of the Cerebral Basal Ganglia and Its Roentgenological Significance, JOHN D CAMP M D, Rochester, Minn  
*Discussion*

- 5 Pulmonary Sarcoidosis, The Early Roentgen Findings, L H GARLAND, M D , San Francisco, Calif  
*Discussion* LEO RIGLER, M D , Minneapolis, Minn , W E CHAMBERLAIN, M D , Philadelphia, Penna , AND GEORGE M WYATT, M D , Washington, D C

- 6 Gout, EDWARD S ROSENBERG M D , AND ROBERT A ARENS, M D , Chicago, Ill

*Discussion*

- 7 The Diaphragm A Radiologic Study in Three Dimensions SAMUEL BROWN, M D , Cincinnati, Ohio

### THERAPY SESSION 2 00 P M

- 1 X-Ray Treatment of Sinusitis in Children, DONALD R LAING, M D , Pasadena, Calif

*Discussion*

- 2 Influence on Radiation Effects Produced by Phar-

macological Means, FRIEDRICH ELLINGER, M D , Brooklyn, N Y

*Discussion* A L L BELL, M D , Brooklyn, N Y

- 3 Treatment of Epitheliomas of the Skin, THEODORE P EBERHARD, M D , Philadelphia, Penna

*Discussion* JUAN A DEL REGATO, M D , Columbia, Mo

### SYMPOSIUM ON ROENTGEN DIAGNOSIS AND THERAPY OF BURSITIS AND ARTHRITIS

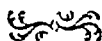
Chairman E A Pohle, M D

Madison, Wis

- 4 The Pathological Aspect, D M ANGEVINE, M D , Madison, Wis

- 5 The Roentgen Diagnostic Aspect, L W PAUL, M D , Madison, Wis

- 6 The Roentgen Therapeutic Aspect, E A POHLE, M D , AND J A NORTON, M D , Madison, Wis



- 2 High Intensity Radiation from Beryllium Window X-Ray Tubes, T H ROGERS, Springdale, Conn (by invitation)

*Discussion*

- 3 Development of the Betatron for Electron Therapy, L S SKAGGS, Chicago, Ill, G M ALMY, D W KERST, AND L H LANZL, Urbana, Ill (by invitation), with Introduction by ERICH M UHLMANN, M D, Chicago, Ill

*Discussion*

- 4 Importance of Alveolar Pressure in the Diagnosis of Pulmonary Disease, DR NILS WESTERMARK, St Göran's Hospital, Stockholm, Sweden (by invitation)

## DIAGNOSTIC SESSION 2 30 P M

- 1 Deformities of the Greater Curvature of the Stomach, MAURICE FELDMAN, M D, Baltimore, Md

*Discussion* KENNETH S DAVIS, M D, Los Angeles, Calif

- 2 Erosive and Proliferative Changes in the Bones and the Soft Tissues of Paraplegics, NORMAN HEILBRUN, M D, AND WM G KUHN, M D, Buffalo, N Y

*Discussion* PAUL C SWENSON, M D, Philadelphia, Penna

- 3 Roentgenologic Aspect of Certain Lesions of Bone Neurotropic or Infectious, JOHN R HODGSON, M D, DAVID G PUGH, M D, AND H H YOUNG, M D, Rochester, Minn

*Discussion*

- 4 Roentgen Diagnosis of Localized Benign Metaphyseal Fibrous Lesions, LILLIAN DONALDSON, M D, Chicago, Ill

*Discussion* C HOWARD HATCHER, M D, Chicago, Ill

- 5 Bagasse Disease of the Lungs—A Preliminary Report DAVID V LEMONE, M D, Columbia, Mo, WENDELL G SCOTT, M D, SHERWOOD MOORE, M D, AND Capt A LINK KOVEN, USPHS, St Louis, Mo

*Discussion* Capt A LINK KOVEN, USPHS

- 6 Acute Obstruction of the Small Bowel—The Value of Roentgenological Examination in Early Diagnosis, JACK SPENCER, M D AND LANGDON T THAXTER, M D, Portland, Maine.

*Discussion*

## THERAPY SESSION 2 30 P M

- 1 Further Observations on the Intra-Vaginal Roentgen Treatment of Cervical Cancer, W WALTER WASSON, M D, Denver, Col

*Discussion* ARTHUR W ERSKINE, M D, Cedar Rapids, Iowa.

- 2 Experience with Nasopharyngeal Carcinoma, VINCENT P GRAHAM, M D, AND RALPH R MEYER, M D, Chicago, Ill.

*Discussion* FRED J HODGES, M D, Ann Arbor, Mich.

## SYMPOSIUM ON LYMPHOBLASTOMA

Chairman R G Willy, M D

Chicago, Ill

- 3 Introduction, R. G. WILLI, M D

- 4 ANNA HAMANN, M D, Chicago, Ill

- 5 LEON JACOBSON, M D, Chicago, Ill

- 6 Therapeutic Use of Radioactive Isotopes, JOHN H. LAWRENCE, Berkeley, Calif (by invitation)

*Discussion*

ANNUAL BANQUET 7 30 P M

Friday, December 6

## GENERAL SESSION 10 30 A.M.

- 1 Studies of Tetraiodophthalmidoethanol as a Medium for Gastro-Intestinal Visualization, GLENN E JONES, WILLIAM E CHALECKE, M D, JOSEPH DEG PH D, JOHN SCHILLING, M D, HAROLD D ROBERTSON, GEORGE H RAMSEY, M D, AND WILLIAM H STRAIN, PH D, Rochester, N Y (by invitation)

*Discussion*

- 2 Studies on Emulsions of Ethyl Iodophenylm decylate as Media for the Visualization of Body Cavities WILLIAM E CHALECKE, M D, GLENN E JONES, MURRAY P GEORGE, M D, EARLE B MAHONEY, M D, AND WILLIAM H STRAIN, PH.D., Rochester, N Y (by invitation)

*Discussion*

- 3 The Endocrine Factors in Pelvic Tumors, with a Discussion of the Papanicolaou Smear Method for Diagnosis, A E RAKOFF, M D, Philadelphia, Penna (by invitation)

*Discussion* J P GREENHILL, M D, Chicago, Ill

- 4 Calcium Phosphorus and Phosphatase as Aids in the Diagnosis of Bone Lesions EDMUND FLINK, M D, Minneapolis, Minn (by invitation)

## DIAGNOSTIC SESSION 2 00 P M

- 1 Infantile Cortical Hyperostoses A New Syndrome, JOHN CAFFEY, M D, New York, N Y

*Discussion* PAUL C SWENSON, M D, Philadelphia, Penna

## SYMPOSIUM ON DISEASES OF THE CHEST

Chairman L H Garland, M D

San Francisco, Calif.

- 2 Reasons for the Common Anatomic Location of Pulmonary Tuberculosis WILLIAM DOCK, M D, New York, N Y (by invitation)
- 3 The First Infection Lesion in Pulmonary Tuberculosis in the Adult HENRY ZWERLING, M D, Berkeley, Calif (by invitation)
- 4 The Roentgen Findings in Early Coccidioidomycosis, HORACE JAMISON, M D, AND RAY CARTER, M D, Los Angeles, Calif

## SECOND INTER-AMERICAN CONGRESS OF RADIOLOGY

Nearly three hundred reservations have been made for North American radiologists who will attend the Second Inter-American Congress of Radiology to be held in Havana, Nov 17 to 22, according to an announcement by Dr James T Case, chairman of the General Committee for the United States. The block of rooms reserved at the Nacional, the headquarters hotel, have long since been disposed of. Additional reservations are being made at the Sevilla-Biltmore. Requests for hotel accommodations should be directed to Mr Mac F Cahal, secretary of the committee, in care of the American College of Radiology, 20 N Wacker Drive, Chicago 6.

Delegates must arrange for air or rail transportation through their local travel agents. Special trains will be operated by the Illinois Central from Chicago and the Atlantic Coast Line from New York. Reservations for the Illinois Central should be made with Mr J C La Combe, 140 South Dearborn, Chicago 3, and for the Atlantic Coast Line with Mr R S Voigt, 16 East 44th Street, New York City 17.

Reservations for special flights to be operated from Chicago and New York to Miami by Eastern Airlines may be made at 120 S Michigan, Chicago 3, or at Park Avenue and 42nd St, New York 17.

All delegates must go *via* air from Miami to Havana, and return, as no steamship service will be available. Reservation forms for Pan American Airways may be obtained from Mr Cahal. Passports are not required.

In addition to the sixteen papers to be read by United States radiologists, there will be eighteen scientific exhibits by delegates from this country. It is expected that copies of the printed program will soon be available for registered delegates.

Representatives on the General Committee for the United States from the three cooperating societies are Dr James T Case, Dr W Edward Chamberlain, Dr Ross Golden, Dr Leon J Menville, Dr E P Pendergrass, Dr B H Orndoff, and Mr Mac F Cahal.

## Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

LE FIBRO-MYOME UTERIN \* STATISTIQUES CRITIQUES ET COMMENTAIRES SUR UNE SERIE PERSONNELLE DE 1,300 CAS DONT 547 INÉDITS. FIBROMYOMATOSE EXPERIMENTALE. PHYSIOLOGIE DE L'OVAIRE IRRADIÉ. By J DUCUING, Professeur de clinique chirurgicale à la Faculté de Médecine de Toulouse, Directeur du Centre Anticancéreux. A volume of 511 pages, with 156 illustrations. Published by Masson & Cie, Paris, 1946.

## Books Reviewed

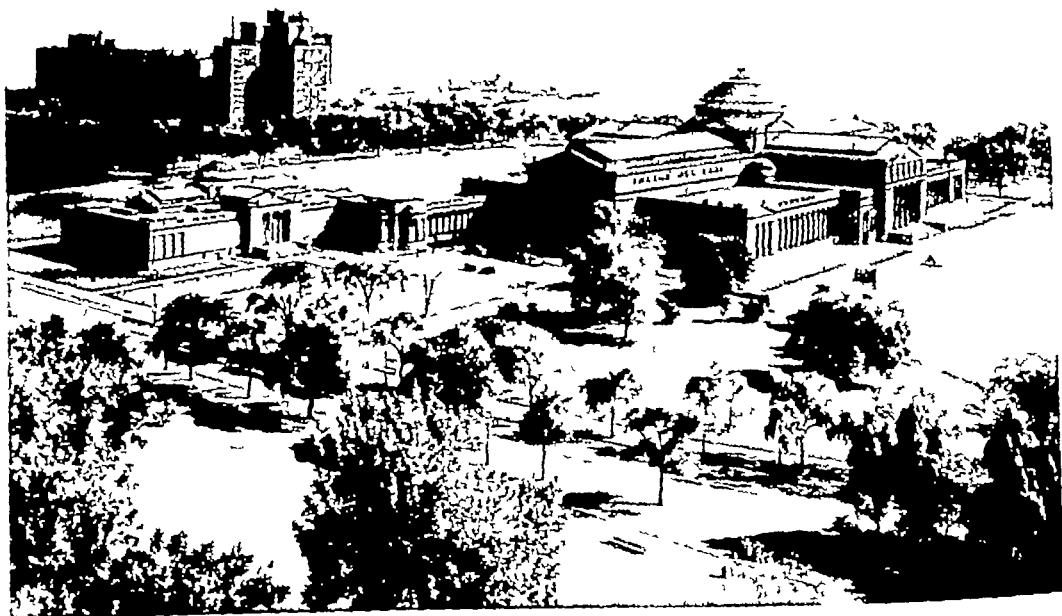
CLINICAL RADIOLOGY, A CORRELATION OF CLINICAL AND ROENTGENOLOGICAL FINDINGS. Edited by CAPTAIN GEORGE UTLEY PILLMORE, MC (S), USNR, Chief Radiologist to the United States Naval Hospital, Philadelphia, during World War II, former Past Assistant Surgeon, United States Navy, during World War I, Chief Radiologist to the United States Naval Hospital, Charleston, S C, to the United States Naval Hospital, Naval Operating Base, Norfolk, Va, to the United States Naval Hospital, Philadelphia, and to the United States Hospital Ship *Mercy* following World War I, former Chief Radiologist to the Bryn Mawr Hospital, Bryn Mawr, Penna, and to the Easton Hospital, Easton, Penna. In two volumes, 1,600 pages, with 2,484 illustrations. Published by F A Davis Co, Philadelphia 1946. Price \$45.00.

In the two large volumes constituting *Clinical Radiology*, edited by Capt George U Pillmore, we have one of the most ambitious works on roentgen diagnosis which has been produced in recent years. As Admiral Ross McIntire states in his brief Foreword, "Radiology is, of all the specialties, the one perhaps most nearly related to every other field of medicine." It is particularly fitting, therefore, that among the 58 contributors to the work there are 19 representing allied clinical branches of medicine and surgery. Many well known names appear in the list, insuring an authoritative presentation based in most instances upon a wide experience.

Volume I includes four main sections, 120 pages are devoted to The Cardiovascular System, 329 to The Respiratory System (exclusive of the paranasal sinuses, which are discussed along with injuries to the facial bones in Volume II), 243 to The Gastro-Intestinal System (more properly the digestive system, since diseases of the salivary glands, esophagus, biliary tract, and pancreas are included), 120 pages to Urology, Gynecology, and Obstetrics.

Volume II is divided into ten parts, though a number of these, all dealing with the skeletal system, might have been logically combined under a single heading. Part I (94 pages) is devoted to The Brain and Related Osseous Structures, Part II (150 pages) to The Vertebrae and Spinal Cord, Part III (54 pages) to The Nasal Accessory Sinuses and Facial Bones, Parts IV to VII, inclusive (a total of 333 pages), to lesions of the bones, joints, and cartilages, including traumatic lesions, inflammatory conditions, disturbances of nutrition and growth, and endocrine, toxic, metabolic, and static disorders. Chapters on Blood Diseases and Bone Tumors go to make up Part VIII (36 pages), The Soft Tissues, Part IX (14 pages), Foreign Body Localization, Part X (43 pages).

It is impossible in any text to include every aspect of radiology with its many ramifications, and a few



*K. ulma n-Fabry Plan*

Museum of Science and Industry, Jackson Park, Chicago, with Lake Michigan in the Background

### RADIOLOGICAL SOCIETY OF NORTH AMERICA

The President's invitation to the Annual Meeting of the Radiological Society of North America and the program, appearing elsewhere in this issue, make unnecessary any detailed announcement in this place. Attention is simply called to the date, Dec 2-6, 1946, and the place, the Palmer House, Chicago. The outline of the Refresher Courses appeared in the September issue of RADIOLOGY.

### UNIVERSITY OF UTAH RADIOLOGICAL CONFERENCE

Announcement has been received of the establishment of the University of Utah Radiological Conference to be held the first and third Thursdays of each month from September to June, inclusive, from 7:30 to 10 P M, at the Salt Lake County Hospital. The conference is under the direction of the

Department of Radiology of the University of Utah School of Medicine for the combined purpose of graduate instruction and staff discussion of diagnostic problems. All physicians are invited to attend and to bring with them interesting or problem cases for presentation.

The speaker at the initial conference was Dr. John Caffey, Associate Professor of Pediatrics, College of Physicians and Surgeons, Columbia University, New York.

### ROCKY MT RADIOLOGICAL SOCIETY

At the midsummer conference of the Rocky Mountain Radiological Society, held in Denver, Aug 8-15, the following officers were elected for the ensuing year: Dr. Lewis G. Allen, President, Dr. James P. Kerby, President-elect, Dr. Ira Lockwood, First Vice President, Dr. H. M. Berg, Second Vice President, Dr. John Bouslog, Historian, and Dr. Alfred M. Popma, Secretary.



# RADIOLOGICAL SOCIETIES OF NORTH AMERICA

*Editor's Note*—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich

## UNITED STATES

*Radiological Society of North America*—Secretary, D. S. Childs, M.D., 607 Medical Arts Bldg., Syracuse 2, N.Y.  
*American Roentgen Ray Society*—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa  
*American College of Radiology*—Secretary, Mac F. Cahal, 20 N. Wacker Dr., Chicago 6, Ill.  
*Section on Radiology, American Medical Association*—Secretary, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio

## ARKANSAS

*Arkansas Radiological Society*—Secretary, Fred Hames, M.D., Pine Bluff. Meets every three months and annually at meeting of State Medical Society

## CALIFORNIA

*California Medical Association, Section on Radiology*—Secretary, D. R. MacColl, M.D., 2007 Wilshire Blvd., Los Angeles 5  
*Los Angeles County Medical Association, Radiological Section*—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building  
*Pacific Roentgen Society*—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with California Medical Association  
*San Diego Roentgen Society*—Secretary, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego, Calif. Meets first Wednesday of each month  
*San Francisco Radiological Society*—Secretary, Joseph Levitin, M.D., 516 Sutter St., San Francisco 2. Meets monthly on the third Thursday at 7:45 p.m., first six months of the year in Lane Hall, Stanford University Hospital, and second six months in Toland Hall, University of California Hospital

## COLORADO

*Dentist Radiological Club*—Secretary, Washington C. Huyler, M.D., Mercy Hospital, Denver 6. Meets third Friday of each month, Colorado School of Medicine

## CONNECTICUT

*Connecticut State Medical Society, Section on Radiology*—Secretary, Max Chiman, M.D., 242 Trumbull St., Hartford 3. Meetings bimonthly, second Thursday

## FLORIDA

*Florida Radiological Society*—Secretary-Treasurer, Max Dull, Jr., M.D., 333 West Main St., S., Gainesville

## GEORGIA

*Georgia Radiological Society*—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N.E., Atlanta 3. Meets in November and at the annual meeting of State Medical Association

## ILLINOIS

*Chicago Roentgen Society*—Secretary, Lay H. Squire, M.D., 1753 W. Congress St., Chicago 12. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April

*Illinois Radiological Society*—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement

*Illinois State Medical Society, Section on Radiology*—Secretary, Frank S. Hussey, M.D., 250 East Superior St., Chicago 11

## INDIANA

*The Indiana Roentgen Society*—Secretary-Treasurer, J. A. Campbell, M.D., Indiana University Hospitals, Indianapolis 7. Annual meeting in May

## IOWA

*The Iowa X-ray Club*—Secretary, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of Iowa State Medical Society

## KENTUCKY

*Kentucky Radiological Society*—Secretary-Treasurer, Sydney E. Johnson, M.D., 101 W. Chestnut St., Louisville

## LOUISIANA

*Louisiana Radiological Society*—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society

*Orleans Parish Radiological Society*—Secretary, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month

*Shreveport Radiological Club*—Secretary, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday, 7:30 p.m.

## MARYLAND

*Baltimore City Medical Society, Radiological Section*—Secretary, Charles N. Davidson, M.D., 101 West Read St., Baltimore 1

## MICHIGAN

*Detroit X-ray and Radium Society*—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms

## MINNESOTA

*Minnesota Radiological Society*—Secretary, A. T. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 26. Meetings quarterly

## MISSOURI

*Radiological Society of Greater Kansas City*—Secretary, John W. Walker, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Friday of each month

*St. Louis Society of Radiologists*—Secretary, Edwin C. Ernst, M.D., 100 Beaumont Medical Bldg. Meets on fourth Wednesday of each month, October to May

## NEBRASKA

*Nebraska Radiological Society*—Secretary-Treasurer, Donald H. Breit, M.D., University of Nebraska Hospital, Omaha 5. Meetings third Wednesday of each month at 6 p.m. in either Omaha or Lincoln

## NEW ENGLAND

*New England Roentgen Ray Society*—Secretary-Treasurer, George Levene, M.D., Massachusetts Memorial

subjects, such as roentgen examination of the teeth, have been intentionally omitted from this treatise. There is included, however, a wealth of material which will make these volumes invaluable to the radiologist and all others who are interested in this specialty.

The book is printed on excellent paper, with abundant illustrative material, beautifully reproduced. While most of the roentgenograms appear in the familiar negative form, a few of the writers have unfortunately not adhered to this plan. A useful feature is the inclusion in each volume of a complete index to the entire work. Captain Pillmore, his contributors, and the publishers are to be congratulated on this splendid publication.

**X-RAYS IN PRACTICE** By WAYNE T. SPROULL, PH D., Physicist, Research Laboratories Division, General Motors Corporation. A volume of 615 pages, including bibliography and index, with numerous illustrations. Published by McGraw-Hill Book Company, Inc., New York, 1940. Price \$6.00.

Dr W. T. Sproull, having been a research physicist in the General Motors Laboratories for more than twelve years, during which time he conducted a great deal of original research, and having had considerable experience as a teacher, both during this time and previously at the University of Wisconsin, is pre-eminently qualified for the task of writing a practical textbook on the general subject of x-rays. He has done just this in *X-Rays in Practice*.

The book is well integrated throughout. Ideas that are presented in connection with one part of the subject material are not compartmented therein to the confusion of the student, but reference is made to the application of these same ideas to other parts, so that the subject matter is a uniform and logical entity throughout.

For presentation, the subject matter is divided up along more or less classical lines, the first chapters having to do with history and the general nature of radiation. A very good chapter on x-ray-generating equipment is followed by a short chapter giving a bare outline of the concepts of radioactivity. Methods of detecting, measuring, and utilizing these radiations are presented with great clarity and a considerable amount of detail in subsequent chapters. Excellent chapters on radiography of all sorts, both

for hard and soft radiation, give quite complete coverage to the subject. The largest single portion of the book, approximately 230 pages (nine chapters), is devoted to diffraction in all of its phases and applications. A short chapter is also included on electron diffraction. The broad general outlines of medical radiology are presented and there is a satisfactory chapter on protection.

Each chapter is supplemented by a section of questions and problems which are remarkably well chosen and suited to teaching purposes. There is also an appendix of useful data and a particularly clear index. The book has an excellent balance of basic theory and practical application throughout, so that at no time is the beginning student led astray or carried too far afield by either one.

In general, the text is suitable to anyone wishing a fundamental knowledge of the subject and useful for teaching in the senior or first year graduate levels. Though manufactured under wartime restrictions, the book is printed on good paper, in clear type, and is well bound.

**DIE UROGRAPHIE BEI DER NIERENTUBERKULOSE RÖNTGENDIAGNOSTISCHE UNTERSUCHUNGEN** By OLLE OLSSON. Supplementum XLVII to *Acta Radiologica*. A volume of 162 pages, with 30 illustrations. Published by Håkan Ohlsson Boktryckeri, Lund, 1943.

This monograph concerns renal tuberculosis leading to ulceration, caseation, and cavity formation. Other renal lesions like miliar tuberculosis and the chronic fibrosing and disseminated nodular forms are excluded. Since it is impractical to cover the contents adequately in a review, a full abstract of the treatise has been included in the Abstract Section of this issue of *RADIOLOGY* (p. 428).

This excellent work is profusely and beautifully illustrated, and the important value of meticulous attention to technical and diagnostic detail is obvious from its perusal. It may well change the concept of many a radiologist and clinician regarding the value of excretory urography in the diagnosis of renal tuberculosis so long as he should be willing to follow the author and his preceptor, Dr. H. Hellmer, in their excellent working manner. Urography—excretion pyelography—is of real value only if employed with the utmost attention to every detail of preparation, technique and evaluation. It will be hard to surpass the work of Olsson.



# ABSTRACTS OF CURRENT LITERATURE

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Hospitals, Boston, Mass Meets monthly on third Friday at Boston Medical Library

#### NEW HAMPSHIRE

*New Hampshire Roentgen Society*—Secretary-Treasurer, Richard C Batt, M D, St Louis Hospital, Berlin

#### NEW JERSEY

*Radiological Society of New Jersey*—Secretary, W H Seward, M D, Orange Memorial Hospital, Orange Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called

#### NEW YORK

*Associated Radiologists of New York, Inc*—Secretary, William J Francis, M D, East Rockaway, L I

*Brooklyn Roentgen Ray Society*—Secretary-Treasurer, Abraham H Levy, M D, 1354 Carroll St, Bklyn 13 Meets fourth Tuesday of every month, October to April

*Buffalo Radiological Society*—Secretary-Treasurer, Mario C Gian, M D, 610 Niagara St., Buffalo 1 Meetings second Monday evening each month, October to May, inclusive

*Central New York Roentgen Society*—Secretary-Treasurer, Carlton F Potter, M D, 425 Waverly Ave, Syracuse 10 Meetings in January, May, and October

*Long Island Radiological Society*—Secretary, Marcus Wiener, M D, 1430 48th St, Brooklyn 19 Meetings fourth Thursday evening each month at Kings County Medical Bldg

*New York Roentgen Society*—Secretary Wm Snow, M D, 941 Park Ave, New York 28

*Rochester Roentgen-Ray Society*—Secretary, Murray P George, M D, 260 Crittenden Blvd, Rochester 7 Meets at Strong Memorial Hospital, third Monday September through May

#### NORTH CAROLINA

*Radiological Society of North Carolina*—Secretary-Treasurer James E Hemphill M D, Professional Bldg Charlotte 2 Meets n May and October

#### NORTH DAKOTA

*North Dakota Radiological Society*—Secretary, Charles Heilman, M D, 1338 Second St, N, Fargo

#### OHIO

*Ohio Radiological Society*—Secretary, Henry Snow, M D, 1061 Reinhold Bldg, Dayton 2 Next meeting at annual meeting of the Ohio State Medical Association

*Central Ohio Radiological Society*—Secretary, Hugh A Baldwin, 347 E State St, Columbus

*Cleveland Radiological Society*—Secretary-Treasurer Carroll C Dundon, M D 11311 Shaker Blvd, Cleveland 4 Meetings at 6 30 p m on fourth Monday of each month from October to April, inclusive

*Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists)*—Secretary-Treasurer, Samuel Brown, M D, 707 Race St, Cincinnati 2 Meetings held third Tuesday of each month

#### PENNSYLVANIA

*Pennsylvania Radiological Society*—Secretary-Treasurer, L E Wurster, M D, 418 Pine St, Williamsport 8

*Philadelphia Roentgen Ray Society*—Secretary, Calvin L Stewart, M D, Jefferson Hospital, Philadelphia 7 Meets first Thursday of each month at 8 00 p m, from October to May in Thomson Hall, 21 S 22d St

*Pittsburgh Roentgen Society*—Secretary-Treasurer, Lester M J Freedman, M D, 415 Highland Bldg, Pittsburgh 6 Meets second Wednesday of each month at 6 30 p m, October to May, inclusive

#### ROCKY MOUNTAIN STATES

*Rocky Mountain Radiological Society*—Secretary, A M Popma, M D, 220 N First St, Boise, Idaho

#### SOUTH CAROLINA

*South Carolina X-ray Society*—Secretary-Treasurer Robert B Taft, M D, 103 Rutledge Ave., Charleston 10

#### TENNESSEE

*Memphis Roentgen Club*—Meetings second Tuesday of each month at University Center

*Tennessee Radiological Society*—Secretary-Treasurer, J Marsh Frère, M D, 707 Walnut St, Chattanooga Meets annually with State Medical Society in April

#### TEXAS

*Dallas-Fort Worth Roentgen Study Club*—Secretary, X R Hyde, M D, Medical Arts Bldg, Fort Worth 2 Meetings on third Monday of each month, in Dallas on the odd months and in Fort Worth in the even months

*Texas Radiological Society*—Secretary-Treasurer, R P O'Bannon, M D, 650 Fifth Ave, Fort Worth 4

#### UTAH

*Utah State Radiological Society*—Secretary-Treasurer, M Lowry Allen, M D, Judge Bldg, Salt Lake City 1 Meets third Wednesday, January, March May, September, November

#### VIRGINIA

*Virginia Radiological Society*—Secretary E Latas Flanagan, M D, 215 Medical Arts Bldg, Richmond 19

#### WASHINGTON

*Washington State Radiological Society*—Secretary-Treasurer, Thomas Carlile, M D, 1115 Terry Ave, Seattle Meetings fourth Monday of each month, October through May, at College Club, Seattle

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*Milwaukee Roentgen Ray Society*—Secretary-Treasurer, C A H Fortier, M D 231 W Wisconsin Ave., Milwaukee 3 Meets monthly on second Monday at the University Club

*Radiological Section of the Wisconsin State Medical Society*—Secretary, S R Beatty, M D, 185 Hazel St, Oshkosh Two-day meeting in May and one day at annual meeting of State Medical Society in September

*University of Wisconsin Radiological Conference*—Meets first and third Thursdays 4 to 5 p m, September to May inclusive, Room 301 Service Memorial Institute 428 N Charter St, Madison 6

#### CANADA

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*La Société Canadienne-Française d'Electrologie et de Radiologie Medicales*—General Secretary, Origène Du Fresne M D, Institut du Radium, Montreal Meets on third Saturday of each month

#### CUBA

*Sociedad de Radiología y Fisioterapia de Cuba*—Office in Hospital Mercedes Havana Meets monthly

## THE HEAD AND NECK

**Prognosis of Subarachnoid Hemorrhage and Its Relation to Long Term Management.** George A Wolf, Jr., Helen Goodell, and Harold G Wolff J A M A 129 715-718, Nov 10, 1945

The authors review the literature and consider 46 additional cases of subarachnoid hemorrhage. Twenty-nine per cent of patients entering hospitals with that condition die during the first episode of bleeding. Fourteen per cent die during recurrence between the second and fourth weeks, and another 5 per cent die by the end of the first year following the initial hemorrhage. The majority of patients surviving for a year are alive three to four years later.

Subarachnoid hemorrhage constitutes 7 per cent of all cerebral vascular disease and accounts for 2 per cent of sudden deaths. Rupture of an intracranial arterial aneurysm is most often responsible.

Symptoms and signs include sudden violent headache, dizziness, vertigo, vomiting, drowsiness, stupor, coma, stiff neck, pain in back of thighs and legs, sweats, chills, fever, Kernig sign, third nerve palsy, delirium, hemiparesis, other evidence of corticospinal tract disease, and fundal hemorrhages.

It is recommended that patients observed within four weeks after the initial hemorrhage be studied by skull roentgenograms and cerebral arteriography and that craniotomy be done if an aneurysm is visualized and if the general condition does not contraindicate surgery. Patients having had their last hemorrhage more than four weeks before initial observation, who present localizing signs of an intracranial lesion, should also have cerebral arteriography with subsequent craniotomy if indications for such are present. If a patient has survived without recurrence for more than four weeks and is without signs or symptoms, arteriography and surgical intervention should be considered optional.

H D WELSH, M D  
(University of Michigan)

**Pituitary Adenoma Associated with Chronic Duodenal Ulcer.** Joseph E Pisetsky J Nerv & Ment Dis 102 537-546, December 1945

Cushing (Surg, Gynec & Obst 55 1, 1932) established a substantial basis for a causal functional interrelationship between the brain and peptic ulcer. Evidently, definite centers exist in the hypothalamus which control and modulate the impulses transmitted to the gastro-intestinal tract. A disturbance in this regulatory mechanism produces tissue changes in the gastric mucosa through various intermediary steps. It seems to be irrelevant whether the disturbed cerebral function is initiated by a cerebral neoplasm, electrical stimulation or by repeated psychic trauma. The end result is a derangement of the physiologic control of the gastro-intestinal tract. Impulses may flow from the cortex to the hypothalamus where they are relayed in turn to the red nucleus and then on their downward path to the centers in the medulla. There a recirculating occurs with stimulation of the vagal and sympathetic systems, with the stomach and intestines acting as effector organs. The functions involved are secretion, motility, and vasomotor innervation, which are also concerned with the genesis of peptic ulcer.

The author found in the literature many specific references to peptic ulcer associated with intracranial operations or intracranial tumors. Several cases accompanying cerebellar tumors have been recorded, but relatively few have been described in association with a hypophyseal or parhypophyseal tumor. Seven cases of pituitary or parasellar lesions accompanied by peptic ulceration of the gastro-intestinal tract were found. Only one of the ulcers was in the duodenum.

The author's own patient was a 42-year-old man who had suffered from headache and pain in both eyes for fifteen years and failing vision for eighteen years. X-ray studies of the skull showed the sella turcica to be enlarged and distorted in shape. [Unfortunately the detail in the reproduction of the skull roentgenogram is too poor to show the changes described.] Physical examination revealed the expected manifestations of pituitary dysfunction. The external genitalia and testes were small, and hair growth was scant and female in distribution. The skin was pale and clear, with poor tissue turgor. No abnormal deposits of fat were present. Telurium therapy was given, 32,500 mg/hr and 33,000 mg/hr to the right and left lateral temporofrontal regions, respectively. Vision in the left eye was never recovered but the patient retained enough vision in his right eye to maintain a daily routine under custodial care and was alive after a history extending over a period of twenty-four years.

The patient had given an earlier history of some abdominal symptoms, and five years after irradiation of the pituitary tumor, pain, vomiting, and nausea led to examination of the gastro-intestinal tract. The first examination showed only pylorospasm, while the second, the following year, demonstrated a deformity of the duodenal cap, giving the impression of an old duodenal ulcer. Symptoms subsequently recurred, but were relieved by a medical regimen.

SYDNEY F THOMAS, M D

## THE CHEST

**The Segments of the Lungs. A Commentary on Their Investigation and Morbid Radiology.** A F Foster-Carter and Clifford Hoyle Dis of Chest 11 511-564, November-December 1945

A bronchopulmonary segment may be defined as a segment of lung served by a principal branch of a lobar bronchus and this branch may be called a segmental bronchus. It is usually large and fairly constant. Each branch of the bronchial tree aerates a separate wedge of lung tissue. Bronchial subdivisions usually follow a characteristic pattern and each lobe is divided into a given number of major segments.

The anatomy of the bronchial tree has been studied by casts, dissections, bronchograms, and air distention of single bronchopulmonary segments. The authors filled bronchopulmonary segments with plasticine and subsequently radiographed the specimens. The article contains illustrations showing the anatomical locations and radiological features of consolidation and collapse of all the bronchopulmonary segments.

Morbid changes of many kinds may be confined to a bronchopulmonary segment, and segmental lesions can

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The anatomy of the bronchial tree has been studied by casts, dissections, bronchograms, and air distention of single bronchopulmonary segments. The authors filled bronchopulmonary segments with plasticine and subsequently radiographed the specimens. The article contains illustrations showing the anatomical locations and radiological features of consolidation and collapse of all the bronchopulmonary segments.

Morbid changes of many kinds may be confined to a bronchopulmonary segment, and segmental lesions can

be detected radiographically. Identification of segmental lesions makes for more accurate diagnosis, hence for better treatment, as in bronchiogenic carcinoma, lung abscess, bronchiectasis, etc.

The authors describe the radiographic picture of each of the major segments of both lungs under conditions of consolidation and collapse. The location of the segments when consolidated is as follows:

**A Right Upper Lobe** (1) The *anterolateral* segment, as seen in the postero-anterior projection, extends from the hilum to the periphery, from the lesser fissure to below the clavicle. In the lateral projection, it extends from the anterior surface to the mid axillary region, and from the lesser fissure to the first rib. (2) The *posterolateral* segment is similar to the anterolateral in location in the postero-anterior view except that the lower margin is less distinct and that usually there is a clear area between the inner border and the mediastinum. In the lateral projection it is seen posteriorly, being limited by the main interlobar fissure, it extends anteriorly to the mid-axillary region. The lower limit is on a level with the lesser fissure, and the upper portion is on a level with D2 or D3. (3) The *apical* segment occupies the apical portion of the lung. In the lateral projection it is V-shaped and extends from the hilum to the apex.

**B Right Middle Lobe** (1) In the postero-anterior projection, the *anterior* segment extends from about the fourth costal cartilage to the diaphragm, and from the right border of the heart about half way out across the lung field. In the lateral projection, it is situated anteriorly, is triangular in shape, with its apex at the hilum, limited above by the lesser fissure, laterally and inferiorly by the main fissure. (2) The *lateral* segment is seen in the postero-anterior projection as a triangular shadow in the right middle zone, with its apex down and the lesser fissure forming its base. The apex is above the diaphragm and in the mid-lung field. In the lateral projection the shadow is also triangular, extending downward and forward from the hilum, bounded above and below by the lesser and main fissures.

**C Left Upper Lobe** (1) The *anterolateral* segment is essentially the same as on the right side. The lower border is not so sharply defined, because there is no limiting fissure, and in the lateral projection the segment extends more posteriorly. (2) The *apico-posterior* segment is equivalent to the combined apical and posterolateral segments of the right lung. (The lingula, the equivalent of the right middle lobe is supplied by the left middle bronchus which divides into two and supplies an anterior and a lateral segment.) (3) The *anterior middle* segment in the postero-anterior projection is triangular in shape and extends from the cardiac apex laterally into the lung field in the region of the anterior ends of the 6th and 7th ribs. In the lateral projection it is triangular and extends from the hilum downward and forward and the fissure forms its inferoposterior border. (4) The *lateral middle* segment appears in the postero-anterior projection as a triangular area in the mid-zone, with its base laterally and its apex at the hilum. The medial border is superimposed on the cardiac silhouette. In the lateral projection it is triangular in shape with its apex at the hilum. Inferoposteriorly it is limited by the fissure. Its superior margin is directed downward and anteriorly. The anterior portion of the segment is superimposed over the cardiac silhouette.

**D The Lower Lobes** The two lower lobes are similar, except that the right has an additional segment, the cardiac. (1) The *dorsal* segment, as seen in the postero-anterior projection, extends across the lung field from the 5th or 8th to the 9th or 10th rib posteriorly. In the lateral projection it is triangular in shape, extending from the main fissure to the posterior chest wall, with its inferior margin sloping downward and backward towards D10, the apex may extend anteriorly to the anterior or mid-axillary region. (2) The *posterior basic* segment occupies the lower inner and posterior portion of the lung field and is triangular in shape in both projections. (3) The *anterior basic* segment extends from the hilum downward and outward and includes the costophrenic area. In the lateral projection it appears as a wedge limited anteriorly by the main fissure. (4) The *middle basic* segment, in the postero-anterior view, resembles but is more lateral than the anterior basic. In the lateral projection it is posterior to the anterior basic, based on the diaphragm. (5) The *right cardiac* segment, as seen in the postero-anterior view, occupies a small area in the right cardiophrenic region. In the lateral projection it casts a small triangular shadow based on the posterior portion of the diaphragm, with the apex pointing upward toward the hilum.

Atelectatic bronchopulmonary segments are considerably smaller and can be recognized.

HENRY K. TAYLOR, M.D.

**The Lateral Projection of the Chest.** Samuel Brown. *Dis of Chest* 11: 596-623, November-December 1945.

From an extensive experience, the author concludes that a roentgenographic examination of the chest made with a postero-anterior and a lateral projection yields considerably more information than a postero-anterior stereoroentgenographic study. From the lateral view, one obtains a more accurate knowledge of the size, shape, and position of abnormal shadows than is possible by stereoscopy in one direction alone, and a more accurate diagnosis is possible. Postero-anterior and lateral roentgenograms of 21 cases are included.

HENRY K. TAYLOR, M.D.

**Intrathoracic Metallic Foreign Bodies.** L. Henry Garland. *Dis of Chest* 11: 662-677, November-December 1945.

This report is based on a study of 150 men with intrathoracic metallic foreign bodies retained from one to twelve months following injury. The metallic fragments varied in size from less than 1 to 40 mm in length and from 1 to 30 mm in diameter. In approximately 20 per cent of the cases the foreign bodies measured 1 cm or more in diameter. About 20 per cent of the patients had associated bony injuries, 75 per cent showed residual pleural changes, 15 per cent pulmonary changes, about 10 per cent showed no significant residual changes in either lungs or pleura. Included in the group were a few mediastinal and pericardial foreign bodies, one intracardiac, and a few interosseous.

The diagnosis is based on the history, presence of a scar, clinical findings, and the roentgen demonstration of a foreign body. Examination should be made in at least two planes, preferably with over-exposure, with other procedures as may be required as tangential spot films, fluoroscopy, stereoroentgenography, tomography, and localizing procedures.



4. The author is especially interested in the late behavior of such cases, particularly since many survivors of the late war are hosts to these foreign bodies. In 80 per cent of the cases there are no symptoms, in 10 per cent, the symptoms may be classified as slight, and in the other 10 per cent as fairly severe. Late complications may result from migration and disintegration, erosion of blood vessels, recurrence of infection, development of herniae, pleural thickening and irritation, and pressure upon the phrenic nerve.

The author concludes that metallic foreign bodies, especially in the late stages (three or four months after injury), are frequently innocuous, that the necessity for removal does not depend upon size, that a bone fragment driven into the lung at the time of the injury is a much greater potential source of trouble than the foreign body itself. HENRY K. TAYLOR, M.D.

**The Bearers of Shadows.** Manoel de Abreu. *Dis of Chest* 11: 639-647, November-December 1945.

The author discusses fluorography, localized tomography, and pulmonary lavage as methods for recognizing and diagnosing tuberculosis in the "bearers of shadows." Photofluorography was considered by him as a possibility as early as 1918, he constructed his first microradiographic apparatus in 1935, and in 1937 inaugurated the first Survey Center in the Rio de Janeiro Public Health Department, using 35-mm film. Tomographic examination is limited to shadow-bearing areas of the lung, and small films are used. Generally, 3 sections are made, at 7, 9, and 11 cm levels from the posterior surface of the thorax. The character of the lesion can be evaluated by this method. In the ill, with little or no expectoration, pulmonary lavage is performed. This is accomplished by anesthetizing the supraglottic and infraglottic regions and instilling 10 to 20 c.c. of physiologic salt solution into the trachea during inhalation. Cough is produced, and the saline-washed material from the tracheo-broncho-alveolar structure is expectorated, collected, and examined for tubercle bacilli. Bacteriological studies, cultures, and guinea-pig inoculations are also made when necessary. HENRY K. TAYLOR, M.D.

**Tuberculosis Control in Hospitals.** A Study Made by the Committee on Hospital Personnel (Leopold Brahdry, Chairman), American Trudeau Society. *Am Rev Tuberc* 52: 539-555, December 1945.

In order to be in a position to outline policies for the post-war development of the country's hospitals, the Committee on Hospital Personnel of the American Trudeau Society, with the co-operation of the American Hospital Association, sent questionnaires to 1,284 hospitals. The purpose was to ascertain which methods were being followed in order to control tuberculosis among patients and personnel. The results from 934 answers are summarized in a series of nineteen tables. About two thirds of these hospitals tuberculin-test their student nurses while 85 per cent examine this group by x-ray. A greater proportion of the larger hospitals take periodic chest roentgenograms of their employees than of the smaller ones. Only 6 per cent x-ray the chests of all patients on admission, and only 3 per cent who do not follow this procedure plan to do so after the war emergency. This indicates the need for an educational campaign among hospital administrators and boards of directors. L. W. PAUL, M.D.

**Tuberculosis in a Tropical Naval Hospital.** Emil Bogen and G. H. Strickland. *Am Rev Tuberc* 52: 490-494, December 1945.

Tuberculosis still remains a serious source of disease, death, and disability in naval personnel despite efforts to prevent it by excluding affected recruits. In one hospital in the Southwest Pacific more than 50 patients with active tuberculosis had been seen in the past five months. In addition there were more than twice that number in whom tuberculosis was suspected but could not be proved with the time and facilities at hand.

Most of the cases developed long after the patients had entered naval service, less than a third having been in service for under two years. The roentgen findings were usually more extensive than was indicated by the history and physical findings. The majority of the patients showed widespread ill defined soft densities in the upper and middle lung fields. Infiltration and exudation were common, while fibrosis and destructive lesions with cavitation were infrequent. Few of the patients showed calcified lesions in the parenchyma or hila. Serial films, when available, showed a marked lability of the lesions.

Although the hospital from which this report was made was located close to the equator, it is not believed that the climate had any effect on the incidence or type of tuberculosis encountered. Only a few cases were found in the natives of the region and less than 10 per cent of those tested had positive tuberculin reactions. Many of the patients apparently contracted the disease while on the high seas or while stationed elsewhere, as indicated by the clinical histories. Of greater importance than the climate are thought to be the crowding together of personnel in inadequate living spaces on board ship, lack of sanitary provisions and ventilation, performance of strenuous physical exertion after the onset of symptoms, and the like.

L. W. PAUL, M.D.

**Silicosis.** A Clinical Study. Howard Dayman. *Am Rev Tuberc* 52: 449-462, December 1945.

Clinical observations on 116 patients with silicosis, 33 of whom came to necropsy, are described. Fifteen patients had simple nodular silicosis. Most of these were free of symptoms and the condition was discovered on routine examination. In the absence of complicating tuberculosis the clinical course in this form of the disease was usually benign, some cases having been observed for periods up to eleven years without material pulmonary change.

There were 15 patients with simple conglomerate silicosis. These patients exhibited in varying degree the symptoms and signs of emphysema, with dyspnea as the initial and cardinal symptom. Roentgenograms showed areas of massive fibrosis often symmetrical and at the level of the hila. In most, nodular shadows were present as well, disseminated throughout the lung fields. The shadows remained unchanged over long periods. The disease ran a protracted clinical course with gradually increasing dyspnea. Of 8 deaths in this group, 4 were due to complicating pulmonary heart disease with cardiac failure. There was no evidence of tuberculosis. The pathogenesis of this form of silicosis is not clearly understood. It is apparent that not all cases of the disease with massive lesions can be classified as "silicosis with infection." It is possible that the bacteriologic and histologic evidence of tuberculosis has been obliterated by the silicotic process.

The third group of 77 patients had silicosis complicated by tuberculosis. The symptoms, although modified by the silicosis, were predominantly those of the tuberculous disease and included, in order of frequency, cough, expectoration, dyspnea, weight loss, fever, pleural pain, and hemoptysis. The chest roentgenogram presented widespread minute shadows similar to those seen in simple nodular silicosis together with larger mottled shadows, usually in the upper portion of the lung fields. Cavities frequently developed in the apical areas. Tubercle bacilli were found in the sputum of 65 of the 77 patients. Sixty-six of this group have died, indicating that silicosis predisposes to progressive pulmonary tuberculosis.

Heart disease due to the pulmonary disease was diagnosed in 26 of the 116 cases. The demonstration of right ventricular enlargement by means of x-ray examination was important evidence, appearing prior to any definite clinical signs. Dilatation and hypertrophy of the right ventricle are attributed to obliteration of the vascular bed of the lung and hypertension in the pulmonary artery. In tuberculosis not complicated by silicosis, such cardiac disease is rarely found.

L W PAUL, M D

**Silicious Exposures in the Fire Brick Industry II Roentgenologic Study** Wayne L Ritter and Paul G Bovard. *J Indust Hyg & Toxicol* 27: 283, December 1945.

To determine the hazard of silicosis to which workers in the fire brick industry might be exposed, chest films were taken, on a voluntary basis, of 878 employees (87 per cent) of seven major plants in Kentucky. An occupational history of each worker was also obtained. Ninety-seven of the men in this series, with terms of employment in the fire brick industry ranging from nine to forty seven years, showed pneumoconiosis, this term being used because the characteristic pulmonary change found was not of the type or magnitude usually accepted in compensation courts as the discrete nodular fibrosis of silicosis. The fibrosis in these cases was uniform and finely granular, seldom showing any tendency to form discrete nodules. The chest films in two cases showed conglomerate silicosis. In both instances the men had spent their entire industrial lives, thirty-two and forty-two years respectively, operating unenclosed dry pan mills.

Twenty-six cases of tuberculosis were discovered in this survey. This is twice the ratio found on mass surveys of the general population in this area. Eleven of the 26 patients were found to have the fine granular fibrosis associated with their type of employment.

**Spontaneous Pneumothoraces Occurring in Patients Undergoing Peroral Endoscopy** Osler A Abbott and H Renault de Oliveira. *J Thoracic Surg* 14: 453-460, December 1945.

Little if any attention has been given to pneumothorax as a bronchoscopic hazard. Five cases are reported here in which pneumothorax complicated endoscopy (4 bronchoscopy, 1 esophagoscopy). An additional case, in which death followed bronchoscopy, is also recorded because of the similarity of the roentgen picture to that of one of the other patients. In no instance was biopsy done or a foreign body removed so that direct injury as an etiologic factor is ruled out. The mechanism of the production of spontaneous pneu-

mothorax is not entirely clear but most commonly there is a pre-existing tuberculosis or other pulmonary lesion, as pneumonia, gangrene, bronchiectasis, abscess, emphysema, tumor, cyst, or emphysema. Rupture of such subpleural lesions may occur, in the case of endoscopic manipulation it may be precipitated by a coughing paroxysm subsequent to the procedure. It is important to recognize this complication of endoscopy so that proper treatment can be instituted when necessary. More frequent fluoroscopic and roentgenographic studies following endoscopy will probably reveal many unsuspected cases, since, as in 2 of the authors' cases, there may be no clinical symptoms. Four of the reported cases occurred during a twelve-month period in a group of 537 bronchoscopies.

HAROLD O PETERSON, M D

**Beryllium Poisoning.** H S Van Ordstrand, Robert Hughes, J M De Nardi, and Morris G Carmody. *J A M A* 129: 1084-1090, Dec. 15, 1945.

One hundred and seventy cases of beryllium poisoning are reviewed by the authors. Manifestations included dermatitis, chronic skin ulcers and inflammatory changes in the respiratory tract, the skin and respiratory changes occurring concurrently or singly. Diffuse pneumonitis was the severest manifestation, accounting for five deaths. In this series of cases, clinical manifestations occurred only after exposure during the processing of beryl ore. Incidence and severity were proportional to the degree of exposure and chemical irritation of dusts and fumes. The specific etiology is unknown. Use of beryllium in the production of beryllium copper alloy, widely used in industry, makes recognition of this disease important, as with increasing production more individuals may be exposed.

Forty-two patients demonstrated contact dermatitis and skin ulcers. Frequently these lesions were associated with rhinitis and nasopharyngitis. Ninety patients had a chemical nasopharyngitis and/or chemical tracheobronchitis. Chief complaints were soreness in nose and throat, with associated mild epistaxis. In 38 workers chemical pneumonitis developed, with cough, substernal pain, shortness of breath, cyanosis, in most cases an abnormal taste in the mouth, weight loss, and increasing fatigue. Onset in each instance was insidious. Signs of infection were conspicuously absent. Roentgenologic changes did not usually appear until two or three weeks after the first symptoms. Changes were bilateral and diffuse, varying with the severity of the disease. In order of their appearance they were: (1) diffuse haziness of both lungs, (2) soft irregular areas of infiltration with prominent peribronchial markings, (3) absorption of soft infiltration and appearance of discrete large or small conglomerate nodules scattered throughout both lung fields, with clearing after one to four months.

Treatment is primarily avoidance of further exposure to beryllium fumes and dusts.

N R SHIPPEY, M D  
(University of Michigan)

**Pneumothorax in Young Adults Descriptive Statistics in One Hundred and Twenty-Six Cases.** Job E Leach. *Arch Int Med* 76: 264-268, November-December 1945.

The data on 126 patients with 129 episodes of spontaneous pneumothorax observed among military pe-

sonnel in the Army Air Forces Training Command are presented, largely in tabular form. In no instance did the onset occur during aerial flight. The ages of the men ranged from eighteen to forty-one years. There were no immediate fatalities. In 23 patients the onset of the spontaneous pneumothorax was gradual, and in 90 sudden. The difference between those exhibiting only mild initial symptoms or none at all (63.5 per cent) and those exhibiting moderate and severe symptoms (36.5 per cent) is statistically significant. There was no association between the severity of the reported symptoms at the onset of the attack and the degree of pulmonary collapse. In 76 patients there was nothing in the past medical history that had any reasonable association with the onset of spontaneous pneumothorax. In 85 of 100 cases the attack occurred when the patient was at rest (48.6 per cent) or during mild physical activity (37.8 per cent). The pneumothorax was of the closed type in 127 instances and of the valvular type in 2. In the majority of cases (59.8 per cent), the pneumothorax was on the right side. Slightly over one half of the patients had degrees of pulmonary collapse estimated at below 33 per cent. A search for the causative factor in 107 of the attacks was fruitless. Seventeen patients were transferred or were still in the hospital at the time of the report. Most of the men recovered without complication and were retained in military service.

**Neurogenic Tumors at the Pulmonary Apex.** Lester W. Paul. *Dis of Chest* 11: 648-661, November-December 1945.

Of the benign tumors most likely to develop in or at the pulmonary apex, the neurofibromas and allied neurogenic tumors are the most common. In all of these the potentiality for malignant change is present.

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Heart disease due to the pulmonary disease was diagnosed in 26 of the 116 cases. The demonstration of right ventricular enlargement by means of x-ray examination was important evidence, appearing prior to any definite clinical signs. Dilatation and hypertrophy of the right ventricle are attributed to obliteration of the vascular bed of the lung and hypertension in the pulmonary artery. In tuberculosis not complicated by silicosis, such cardiac disease is rarely found.

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mothorax is not entirely clear but most commonly there is a pre-existing tuberculosis or other pulmonary lesion, as pneumonia, gangrene, bronchiectasis, abscess, emphysema, tumor, cyst, or emphysema. Rupture of subpleural lesions may occur, in the case of endoscopy manipulation it may be precipitated by a coughing paroxysm subsequent to the procedure. It is important to recognize this complication of endoscopy so the proper treatment can be instituted when necessary. More frequent fluoroscopic and roentgenographic studies following endoscopy will probably reveal many unsuspected cases, since, as in 2 of the authors' cases, there may be no clinical symptoms. Four of the reported cases occurred during a twelve month period in a group of 537 bronchoscopies.

HAROLD O. PETERSON, M.D.

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One hundred and seventy cases of beryllium poisoning are reviewed by the authors. Manifestations included dermatitis, chronic skin ulcers, and inflammatory changes in the respiratory tract, the skin and respiratory changes occurring concurrently or singly. Diffuse pneumonitis was the severest manifestation, accounting for five deaths. In this series of cases, clinical manifestations occurred only after exposure during the processing of beryl ore. Incidence and severity were proportional to the degree of exposure and chemical irritation of dusts and fumes. The specific etiology is unknown. Use of beryllium in the production of beryllium copper alloy, widely used in industry, makes recognition of this disease important, as with increasing production more individuals may be exposed.

Forty-two patients demonstrated contact dermatitis and skin ulcers. Frequently these lesions were associated with rhinitis and nasopharyngitis. Ninety patients had a chemical nasopharyngitis and/or chemical tracheobronchitis. Chief complaints were soreness in nose and throat, with associated mild epistaxis. In 38 workers chemical pneumonitis developed, with cough, substernal pain, shortness of breath, cyanosis in most cases an abnormal taste in the mouth, weight loss, and increasing fatigue. Onset in each instance was insidious. Signs of infection were conspicuously absent. Roentgenologic changes did not usually appear until two or three weeks after the first symptoms. Changes were bilateral and diffuse, varying with the severity of the disease. In order of their appearance they were (1) diffuse haziness of both lungs, (2) small irregular areas of infiltration with prominent peribronchial markings, (3) absorption of soft infiltration and appearance of discrete large or small conglomerate nodules scattered throughout both lung fields, with clearing after one to four months.

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personnel in the Army Air Forces Training Command are presented, largely in tabular form. In no instance did the onset occur during aerial flight. The ages of the men ranged from eighteen to forty-one years. There were no immediate fatalities. In 23 patients the onset of the spontaneous pneumothorax was gradual, and in 90 sudden. The difference between those exhibiting only mild initial symptoms or none at all (63.5 per cent) and those exhibiting moderate and severe symptoms (36.5 per cent) is statistically significant. There was no association between the severity of the reported symptoms at the onset of the attack and the degree of pulmonary collapse. In 76 patients there was nothing in the past medical history that had any reasonable association with the onset of spontaneous pneumothorax. In 85 of 100 cases the attack occurred when the patient was at rest (48.6 per cent) or during mild physical activity (37.8 per cent). The pneumothorax was of the closed type in 127 instances and of the valvular type in 2. In the majority of cases (59.8 per cent), the pneumothorax was on the right side. Slightly over one half of the patients had degrees of pulmonary collapse estimated at below 33 per cent. A search for the causative factor in 107 of the attacks was fruitless. Seventeen patients were transferred or were still in the hospital at the time of the report. Most of the men recovered without complication and were retained in military service.

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**Cystic Tuberculosis of the Bone in a Case of Milary Tuberculosis.** Russell J Blattner and Chieh Sung J *Pediat* 27: 579-582, December 1945

Tuberculous processes in the long bones of children may be divided into two groups according to location, those in the diaphysis and those in the metaphyso-epiphyseal region. A lesion in the diaphysis is modified by periosteal reaction, while one in the metaphyso-epiphyseal region results in a cystic structure. The latter is a comparatively rare condition, especially in infants or very young children, the first case in the United States having been reported in 1931 (Schwentker *Am J Dis Child* 42: 102, 1931).

A case of cystic tuberculosis of the metaphysis and epiphysis of the tibia in a 2-year-old child, with milary tuberculosis and tuberculous meningitis, is reported. On routine fluoroscopy, all of the bones appeared normal except for a defect at the site of the tuberosity of the right tibia. Careful palpation revealed an area of softness here. There was no swelling of the subcutaneous tissue and no sign of periosteal reaction. The knee joint was not involved. The bony defect was filled out by caseous material which, being less radiopaque, gave the lesion a cystoid appearance on the anteroposterior view and a punched-out appearance on the lateral view. There was no roentgen evidence of bony regeneration or sequestral formation. Direct smear of material (4 c.c. thick white pus admixed with blood) aspirated from the area of the bony defect revealed numerous acid fast bacilli, many in clumps. Inoculation of this material into two guinea pigs produced tuberculosis. The patient died on the eighth hospital day. Autopsy showed an acute milary tuberculosis of the lungs, liver, spleen, and leptomeninges. Microscopic section of a fragment of necrotic bone removed from the right tibia revealed typical tuberculous involvement.

**Neurogenic Ossifying Fibromyopathies. A Preliminary Report.** Arthur B Soule, Jr J *Neurosurg* 2: 485-497, November 1945

Sixty-one patients who had sustained trauma of the spinal cord and one with spinal cord disease of unknown nature, all with paraplegia of the lower extremities, were examined radiographically. "Scout" films of the lower extremities were made in the anteroposterior projection. Additional views—stereoscopic anteroposterior, lateral, and oblique projections—were taken of the affected parts of some of the patients. "Scout" roentgenograms were also taken of the upper extremities in several cases with abnormal findings in the lower extremities but none of these revealed any abnormalities.

In all but 4 of the 61 cases of traumatic origin there had been immediate complete loss of motor and sensory function distal to the involved areas. At the time of examination, these 4 patients showed clinical signs of improvement, and roentgenograms revealed absence of osteoporosis and no evidence of abnormal ossifications. In 23 other traumatic cases there were on admission clinical signs of returning function. Fifteen of these patients had lesions of the cauda equina. Only 3 of the improved patients had ossifications in the soft tissues.

Of the 27 unimproved patients 10 showed varying degrees of osteoporosis in the bones of the lower extremities. In the entire series of 62 patients, the only ones who had marked osteoporosis were 2 of those showing improvement both with lesions of the cauda equina,

and one unimproved patient with osteoporosis in the bones of each tarsus but not elsewhere.

Of the 35 unimproved patients, 20 showed soft-tissue ossifications—3 about both hips and both distal femora, 2 about both hips and one distal femur, 6 about both hips alone, 3 about one hip alone, 4 about both distal femora alone, 2 in one distal thigh alone. Of the 23 improved and unimproved patients with ossifications, 11 showed no osteoporosis, 8 slight osteoporosis, and 4 slight osteoporosis near the hips and knees and moderate osteoporosis in the bones about the ankles and in the feet. Of the patients with ossifications, 19 had lesions of the thoracic cord with dermatome levels ranging from T-3 to T-10, one had a lesion of the lower cervical cord with sensory level at C-7, 3 had lesions of the cauda equina with motor and sensory loss below the L-1 dermatome.

There was no significant difference in the blood total protein and calcium levels in the patients with ossifications and those without. In those with ossifications, however, the average blood phosphorus level was 4.7 mg and the average phosphatase level was 6.2 mg, as compared with 3.9 mg and 5.2 mg in the absence of ossifications.

In the early stages, the soft-tissue deposits had a more or less amorphous, cloud-like roentgen appearance, similar to that observed in developing ossification of a hematoma. Even in the earliest cases, however, there was a definite tendency toward linear and trabecular structure.

In all patients examined three months or more after injury, the deposits were characterized by trabeculated cancellous bone with slender, interlocking strands enclosing small ovoid or lozenge shaped spaces between them. While some of the masses were discrete and moderately dense, in other areas the bone was laid down in sheets or bands, which appeared to be distributed along muscle or fascial planes.

About the hips, the deposits were extracapsular and most extensive above and anterior to the femoral necks and greater trochanters, although scattered osseous masses appeared about all margins and surfaces of the hip-joint capsules. When well developed, the deposits partially ensheathed the hip, extending from the pelvis about 1 cm. peripheral to the outer margins of the acetabulum to the upper shaft of the femur, to which they were attached a short distance below the lesser trochanter. The deposits about the knee were most prominent in the region of the medial collateral ligament, where in several cases they resembled the ossifications of Pellegrini-Stieda disease. In most cases, however, they were more extensive, with bands of osseous tissue extending upward over the arch of the medial condyle, where they appeared to be attached to the periosteum of the distal third of the shaft of the femur. Ossifications were less abundant lateral to the knee, but here also they assumed a pattern similar to those on the medial side.

Some of the ossifications terminated abruptly at the level of the knee joint space. In other cases, they extended about 1 cm. beyond the joint space. No ossifications were observed anterior or posterior to the knee. Films in several cases showed isolated small islands of bone deep in the soft tissues of the thigh.

Soft tissue ossifications of the extremities, chiefly in the vicinity of the hips and knees, constitute an apparently common complication of injury or disease of the spinal cord and cauda equina. This condition is to

**Practical Aspects of Peptic Ulcer Management Under Service Conditions** John R Twiss and Eugene V Parsonnet J A M A 129 857-861, Nov 24, 1945

Of 5,379 patients entering a large Naval hospital, 238 had disease of the gastro intestinal tract. Included in this group were 10 proved cases of gastric and 72 of duodenal ulcer. In 46 of the 82 instances the ulcer was service-incurred, with an average period of two years between enlistment and onset of disability, 36 ulcers were not service incurred and in these a period of approximately six months elapsed between enlistment and appearance of symptoms.

The etiology of peptic ulcer is discussed and the literature reviewed. Psychogenic constitutional states, together with problems of military service and the attendant physiologic disturbances, seem to be the essential factor in the production of ulcer. Diagnosis depends on a clinical history of pain, particularly related to meals, evidence of bleeding, and positive x-ray findings of ulcer. Such positive findings were present in 79 cases.

Confinement to bed with only bathroom privileges, a diet of milk and cream every two hours progressing to a full modified type of Sippy diet, amphotel or other antacid medication, belladonna, mild sedation, and vitamin supplements constitute treatment. All patients are treated for a minimum of six weeks, with the initial period of bed rest lasting two weeks. Control of exciting emotional factors is important. Smoking is prohibited. No liberty is granted until the patient is symptom-free and able to tolerate a regular diet.

Treatment time and modifications of the routine vary according to individual response. Improvement is based on amelioration of subjective symptoms and x-ray findings on check-up examination six weeks after the original. Follow-up films in 46 cases revealed apparent healing in 20, decrease in crater size in 10, residual deformity without crater in 8, and no change in 8. Subtotal gastrectomy was deemed advisable in 4 cases.

Thirty-five patients with service-incurred and 34 with ulcer not service-incurred were released, with 13 returning to limited duty. It is the opinion of the authors that no one with a history or findings of peptic ulcer should be admitted to the Armed Forces, and early separation from service in all cases of peptic ulcer is recommended.

H D WELSH, M D  
(University of Michigan)

**Hookworm Disease A Small Intestinal Study** Philip J Hodes and George P Keefer Am J Roentgenol 54 728-742, December 1945

Serving with a General Hospital in the Province of Assam in India, the authors had an opportunity to study hookworm disease as it developed in American troops. Their report is based upon a study of 125 patients, all with positive stools. Previous studies had indicated that hookworm disease produced changes in the roentgen appearance of the small intestine, simulating the so-called "deficiency pattern."

In 80 per cent of the authors' cases, the disease was believed to be less than three months in duration. Most of the men gave a history of itching after lying in foxholes for several hours, usually developing several hours following exposure and lasting from four to seven days. A dry cough appearing one to two weeks after the "ground itch" was common. Gastro-intestinal complaints developed from six to twenty-five weeks

after exposure, pain being the most prominent symptom. Anemia was not encountered except in three instances of heavy infestation.

In 60 per cent of the patients gastro-intestinal abnormalities were demonstrable on roentgen examination. The esophagus, stomach, and duodenal bulb were usually normal. The earliest abnormalities were found in the proximal jejunum, later spreading to the distal duodenum, the distal jejunum, and the entire ileum. These changes were those of "disordered function" characterized by excessive peristalsis, segmental contractions, and distortion of the mucosal pattern. Jejunal tenderness was an early sign. Increased tone was manifested by narrowing of the lumen. Mucosal distortions varied with the severity of the disease. As it progressed, the folds became increasingly thickened and distorted. In some patients, improvement in the roentgen manifestations occurred early after the institution of treatment. In others a return to normal was delayed and the changes not infrequently persisted for months after the patient was well clinically.

The various theories offered to explain the small intestinal changes in hookworm disease are discussed. It is believed that injury to the intramural nervous system by the hook-like teeth of the parasites may be a factor.

L W PAUL, M D

## THE MUSCULOSKELETAL SYSTEM

**The Roentgen Picture of the Tabetic Arthropathies and Affections of Bones** P Flemming Möller Acta radiol 26 535-547, Nov 30, 1945

Bone and joint changes in tabes dorsalis follow the tabetic changes in the spinal cord and are roentgenologically identical with the lesions found in syringomyelia and more rarely in other diseases of the spinal cord. The typical roentgen findings are dependent upon the increased fragility of the bone and the frequency of spontaneous fractures following slight trauma. In addition, because of the anesthesia due to the disease, the fracture is relatively painless and the patient continues to use the part with resultant comminution of the fracture, soft-tissue injury, and extensive calcification around the fracture site.

Eighty per cent of tabetic bone and joint lesions occur in the lower extremities, while in syringomyelia 80 per cent occur in the upper extremities. Characteristically, the fractures and joint lesions are associated with dislocations, extensive new bone formation, bizarre calcification in the soft tissue, and much bony debris. At the hip joint, fracture occurs close to the head, giving the effect of a shearing fracture and is sometimes associated with almost complete absorption of the head fragment. In the spine, there are bizarre dislocations with marked bony proliferation. Changes in the knee, ankle, and foot are similar. Tabetic flatfoot is frequent, with multiple involvement of the tarsals, metatarsals, and first phalanges and the respective joints, with subsequent collapse of the arch.

Roentgen diagnosis is usually not difficult. Confusion with tuberculosis or tumor may occur, however, and secondary infection may complicate the findings. Incipient tabetic arthropathies of the hip and knee joints may be mistaken for simple arthritis deformans, especially if the changes are of a chronic nature, but the absence of subchondral cystic formations in the tabetic lesions, as well as their more rapid development, are differentiating features.

ELIZABETH A CLARK, M D



**A Rare Anomaly in the Elbow—Patella Cubiti.** P M Kjelland *Acta radiol* 26 491-496, Nov 30, 1945

Roentgenographic findings in two cases of patella cubiti are presented. In one case, arthrography was done and extension of the joint cavity upward, similar to the suprapatellar bursa at the knee, was demonstrated. In both instances the anterior surfaces of the bones appeared to be covered with cartilage. In neither case was there a history of trauma sufficient to have caused fracture with subsequent pseudarthrosis.

Ontogenetically, patella cubiti occurs in several of the lower orders, and in man the epiphysis for the olecranon is sometimes double. From these observations, the author concludes that patella cubiti is a true accessory bone.

ELIZABETH A CLARK, M D

**Arachnodactyly—Unusual Complication Following Skull Injury.** Wilnot F Schneider *J Pediat* 27 583-588, December 1945

This paper should perhaps have been entitled "Marfan's Syndrome Complicated by Skull Injury." The author traces the appearance, in his patient, of the various anomalies found in Marfan's syndrome—delayed development apparent before the age of two, a spontaneous fracture of the femur, probably due to fragility of the long bones, between the ages of two and four, and progressive loss of vision, for which no glasses were prescribed. At the age of thirteen, when almost blind, the patient fell down an open cellar door. She was unconscious for some time and received cuts about the arms, legs, and eyes. Within two to three weeks the left eye became prominent. Ophthalmologic examination revealed subluxation of the lens, retinal detachment, and bilateral glaucoma. The patient's mental age was approximately five years and the intelligence quotient 37. The typical clinical and roentgen features of Marfan's syndrome—"spider hands and feet," rarefaction and spindly appearance of the bones of the hands and feet, with decreased subcutaneous tissue—were present.

**Anterior Sacral Meningocele.** Case Report. M Hunter Brown and Lester D Powell *J Neurosurg* 2 535-538, November 1945

The clinical and roentgenographic features in a successfully treated case of anterior sacral meningocele are described. Roentgenograms of the lumbar spine and coccyx showed the characteristic "scimitar sacrum." Myelography with pantopaque, demonstrated free communication between an extended terminal theca and the upper portion of the meningocele sac. The technical aspects of primary excision and closure are presented with a view to standardizing surgical treatment of this unusual lesion.

**Roentgenological Study of the Male Sacrum as an Aid in Caudal Analgesia.** Percival A Robin and Vincent J Collins *Anesthesiology* 6 505-514, September 1945

In 50 unselected cases the sacrum was studied roentgenologically prior to caudal analgesia. Subsequently the independent observations of the anesthesiologist and roentgenologist were analyzed. A routine anteroposterior view of the sacrum was obtained to determine the apex of the caudal canal and to measure the transverse diameter of the caudal hiatus at the level of the fourth sacral segment. For the lateral view,

body-section roentgenography was used to delineate more accurately the caudal canal. Three lead markers were placed on the skin along the approximate mid-line of the sacrum and three or four planigraphic sections were made close to the mid-line. A routine lateral view of the sacrum employing good roentgen technique, resulting in sharp end-points, is probably equally reliable. The following points were disclosed in the lateral film: the anteroposterior diameter of the opening of the caudal canal, the caliber of the lumen of the entire canal, the size of the cornua, and the configuration of the sacral curve.

In 8 patients the needle could not be introduced into the caudal canal, and in 3 the caudal canal was entered by force. The roentgen findings in these cases are described. The significant anatomic features, revealed by roentgenography, which contributed to unsuccessful analgesia were a narrowed anteroposterior diameter, absence of hiatus, blocked lumen, and agenesis of the posterior wall of the caudal canal. The importance of roentgen studies prior to caudal analgesia is emphasized.

## THE SPINAL CANAL

**Pantopaque Meningitis Disclosed at Operation.** I M Tarlov *J A M A* 129 1014-1016 Dec 8, 1945

A single case of pantopaque meningitis in a 37-year-old male is reported. Myelography was done in course of investigation of chronic low back pain. Neurologic examination was negative. Five hours following intrathecal injection of 3 cc of pantopaque the patient complained of generalized headache and stiffness of the neck and there was temperature elevation to 100.8°. On the following day the temperature rose to 102° and a day later, when interlaminar exploration was done, nuchal rigidity persisted, although fever had lessened. No evidence of herniated disk was found. The spine and lamina of L4 were removed, and on opening the dura and arachnoid considerable whitish, soft, stringy exudate adherent to the arachnoid and nerve roots of the cauda equina was seen. Pantopaque was removed from the subarachnoid space.

Histopathologic study of the exudate disclosed a meshwork of fibrin strands with embedded polymorphonuclear leukocytes, lymphocytes, and plasma cells. No organisms were cultured from this material.

In view of the symptoms, there is little doubt that inflammatory reaction was widespread within the subarachnoid space. Recovery was uneventful.

This report serves to emphasize a potential hazard attached to the use of pantopaque. To lessen the likelihood of such reaction, immediate complete removal of the medium following myelography is indicated.

JOSEPH HANBLIN, M D  
(University of Michigan)

## GYNECOLOGY AND OBSTETRICS

**Skiodan as a Contrast Medium in Utero-Salpingography.** Lyman W Mason *Rocky Mountain M J* 42 942-943, December 1945

Because of the extreme slowness with which lipiodol is absorbed from the peritoneal cavity and the irritative effect of the retained oil in certain instances, the authors employed skiodan for uterosalpingography in two cases. The latter medium, which has long been

be differentiated from the atrophic type of lesion with impaired motor nerve function and the osteoarthropathic type of lesion with impairment of afferent nerve function. Due to the preliminary nature of this study, no conclusions are drawn. Several avenues of future investigation are suggested.

**Pathogenesis of Localized Fibrous Lesions in the Metaphyses of Long Bones** C. Howard Hatcher  
Ann Surg 122 1016-1030, December 1945

Localized benign fibrous lesions situated in the metaphyses of long bones have been described under a variety of diagnoses. Over emphasis on various secondary characters prominent in the natural course of this condition accounts for the diverse interpretations placed upon it. It has been described as solitary xanthoma, solitary bone cyst, benign giant-cell tumor, non-suppurative fibrous osteomyelitis, and as non osteogenic fibroma of bone.

The present report is based on a study of 45 patients in whom 51 lesions of the type under discussion were identified. In all cases of this group, the lesions were in the long bones of the lower extremities. 32 in the distal portion of the femur, 11 in the proximal portion of the tibia, 5 in the distal metaphysis of the tibia, and 2 in the distal third of the fibula [one unaccounted for]. All of the lesions were situated in the metaphysis or the adjacent shaft, where they are usually eccentrically placed. The defect often abuts on the cortex or occupies a portion of it. In 5 cases, multiple lesions were present. In all but 7 of the patients, the abnormality was recognized in childhood, indicating that the disorder has its inception during the period of longitudinal bone growth.

Symptoms are usually mild. In several cases, the lesion was discovered incidentally in making radiographic studies for other purposes. Pain, when present, is usually slight, intermittent, and often referred to the neighboring joint. Local tenderness may be present when the area is in, or close to, the cortex. Symptoms or physical findings of epiphyseal disturbances led to the discovery of the associated metaphyseal defect in 14 of the present series.

The roentgenographic appearance of the metaphyseal defect is distinctive and along with the clinical findings should make the diagnosis quite certain. Early in the disease, there is a limited area of reduced density in the metaphysis close to the epiphyseal disk. Later, the area is apt to be elongated in the direction of the axis of the bone and show sharp demarcation from surrounding normal bone by a shell of bony sclerosis. Irregularly scalloped margins give the appearance of loculation. Later on, through longitudinal growth of the bone, the defect comes to lie farther from the epiphyseal cartilage. In the process of tubulation of the metaphysis, the defect may eventually occupy a part of the cortex. In that event, periosteal reaction may produce the shadow of overlying periosteal new bone. In lesions long present there may be radiographic evidence of progressive ossification at the periphery, with resulting marginal sclerosis several millimeters in width. Sometimes dense ossification may fill out part or all of the area, leaving a zone of increased density in the radiograph.

In 17 cases of this group, material was removed for study. The pathological appearance varies with the age and activity of the lesion just as does the radiological appearance. Different areas in the same focus may

yield a wide variety of findings. The basis of the lesion in all stages is a fibrous connective tissue which occupies a smooth-walled, sometimes partially loculated, cavity in the bone. The recently formed focus shows a relatively cellular fibrous tissue with scattered multinucleated cells while, in what appears to be a somewhat older lesion, the fibrous tissue is arranged in strands and whorls. Numerous areas of recent hemorrhage and blood pigment are seen. Multinucleated cells may be more numerous than in the early stage. Lymphoblasts are found scattered through the fibrous tissue. Lipid-filled macrophages are often present in focal collections or diffusely scattered throughout defects where radiographic evidence indicates a lesion of long duration. The lipid deposition is evidence of chronicity and not a primary feature of the disorder.

Disturbances in the epiphyseal bone and cartilage were found in conjunction with the metaphyseal defect in 14 of 45 patients. Osteochondritis of the tibial tubercle or Osgood-Schlatter's disease was the most typical disturbance, present in 8 patients. Osteochondritis dissecans of the femoral condyle was present in 4 cases, and osteochondritis of the patella in 2. Disturbance of growth from the epiphyseal cartilages about the knee from unknown cause was associated with a defect in the femoral metaphysis in 1 patient.

Since the metaphyseal defects are found commonly in childhood and rarely in adult life, it is obvious they must undergo spontaneous healing. The defect found in the metaphysis of a young child may heal rapidly by reparative ossification or, if it is located near the margin of the metaphysis, longitudinal growth and tubulation of the bone may cause it to be displaced to the outer surface of the bone and obliterated. If early repair does not occur, and the lesion is so situated that it is not carried to the outer surface, it usually becomes encapsulated by a dense sclerotic wall. Such a focus may then undergo gradual obliteration by ossification from its walls. Sometimes this will result in restitution of normal architecture of the region, but sometimes a localized hypertrophy of bone will remain to mark the site of the previous lesion.

The author gives several case histories illustrative of various aspects of this disease, with excellent radiographic reproductions. The etiology is still entirely unknown, but the association with demonstrable epiphyseal disorder is considered significant. The only treatment indicated is for the associated disorders.

HERNARD S. KALAJIAN, M.D.

**Hereditary Deforming Chondrodysplasia** William D. Stubenbord  
South M. J. 38 816-819, December 1945

Hereditary deforming chondrodysplasia, or Ollier's disease, is a developmental disorder, the chief features of which are multiple exostoses and irregularities in growth of the epiphysis. The disease is congenital in origin and frequently several members of the same family are affected. Transmission is said to take place through the male.

The author reports a case in a girl of 13, whose paternal grandfather, mother, and several siblings were known to have similar deformities. Roentgenograms of the long bones are reproduced, showing multiple exostoses along the course of muscle attachments, arising in the metaphyseal portions of the long bones.

FRANCIS B. MARKUNAS, M.D.

and non-surgical forms of renal tuberculosis, including the so-called nephrocirrhosis. European and American authors follow a somewhat divergent line of argumentation, but the conclusion may be drawn that the early form of clinical renal tuberculosis represents a pathologic anatomic concepts a solitary papillary lesion communicating with the renal pelvis. This is amenable to roentgenologic demonstration by contrast delineation, and its roentgen diagnostic symptom is the demonstration of a papillary defect, in other words, it is analogous to the 'niche symptom' of a gastric ulcer.

Regarding as minimal cases only those with involvement of a single papilla, the author gives four instances of such a demonstration. It is emphasized that ureteral compression is to be applied for quite a long time in order to obtain such optimal demonstration of minimal lesions. As sources of error are mentioned: minor variations in the normal shape of calices, beginning pyelovenous and tubular reflux, non-tuberculous papillary necrosis in pyelonephritis, especially of diabetics, tumor, pyelitis cystica, caliceal diverticula, pyelogenous cyst, and blood clots. Exposures at various angles may lead to a differential diagnosis, together with a careful evaluation of all clinical data.

It should be kept in mind that a pathologic process may be of such minute size that it can escape detection, furthermore, there is hardly any chance for radiologic detection if the lesion does not communicate with the lumen of the pelvis, or if the communication is not patent to contrast fluid.

Changes in the configuration of the renal lumina result from expanding or shrinking parenchymal processes and the dislocations produced thereby. In rare instances the pelvis may be infected primarily and such involvement may lead to a caliceal stenosis which, however, will require a most careful analysis, especially with due regard to the primary anatomy of the organ and its lumina.

Reviewing his entire material, the author points out that all cases but one—102—presented urographically demonstrable changes. He emphasizes, however, that the roentgen image not infrequently may be regarded as characteristic for tuberculosis, but should not be considered as pathognomonic by itself. A diagnosis of renal tuberculosis on an exclusively radiologic basis is not justified. It should be the object of a radiologic examination either to arouse or confirm a suspicion of such infection. The radiologic indication for a nephrectomy should be a demonstration of pathologic changes rendering such surgical intervention advisable, regardless of whether or not they may be specific in nature.

The remainder of the monograph contains detailed case histories.

For a critical evaluation of this work, see the Book Review section in this issue of RADIOLOGY (page 414).

H A JARRE, M D

**Intramuscular Urography** Benjamin Levant and James J Lee. Pennsylvania M J 49 255-257, December 1945.

Investigation of the urinary tract by the intramuscular injection of diodrast is considered by the authors to be the method of choice in children. It has the advantage over the intravenous and subcutaneous methods of being easily and quickly carried out, with a resultant minimum of crying.

The patient is placed face downward on a table and a 35 per cent (undiluted) solution of diodrast is injected intramuscularly into each buttock, with a 21-gauge needle and a 20-c c. syringe. The total dose varies from 10 to 20 c.c. A flat plate is taken before the injection, and films are taken ten, twenty, and thirty minutes later.

Tests for sensitivity may be done by placing a drop of the solution in the eye, the intradermal test, or placing 2 c.c. of diodrast in the mouth for two minutes and having the patient swallow it.

The authors recommend a cathartic, overnight dehydration, and no breakfast. If the abdomen is shown by the flat plate to be full of gas, castor oil and enemas are given and the patient returns for urography two days later.

The films obtained by the method described have been superior to those obtained by the intravenous and subcutaneous methods. Forty-two children ranging in age from one month to fifteen years have been examined. There have been no local or general reactions.

JOSEPH T. DANZER, M D

**Necrosis of the Renal Papillae Following Retrograde Pyelography** V Eskelund. Acta radiol 26 548-554, Nov 30, 1945.

Although retrograde pyelography is usually without complications except for mild local irritation, the possibility of damage to the kidneys of patients with poor renal function and whose general condition is unfavorable should be borne in mind. The case reported here occurred in a 55-year-old woman with a known chronic pyelonephritis which had not responded to drug therapy. The procedure was done with 25 per cent Hippodim (sodium ortho-iodine hippurate) and was followed by reduction in urinary output, rise in blood urea nitrogen, and fever. The patient died in uremia less than one month later.

At autopsy the kidneys were rather small, with loss of normal markings on cut section and with necrosis of the apices of the papillae. Grossly, no crystalline precipitates were visible. Microscopically, there was acute and chronic pyelonephritis, with a number of small crystalline bodies within the tubules. These "micro-liths" had neither the characteristics of sulfathiazole nor of other crystalline bodies usually found in the kidneys. The complete necrosis was confined to the renal papillae.

Because of the immediate reaction following pyelography, the subsequent course, which lasted almost four weeks, and the microscopic findings, the author presents the case as one of renal damage due to Hippodim probably superimposed on damage due to previous sulfathiazole therapy in diseased kidneys.

ELIZABETH A. CLARK, M D

**Renal Calculi Associated with Hyperparathyroidism** Edward N Cook and F Raymond Keating, Jr. J Urol 54 525-530, December 1945.

The purpose of this paper is to re-emphasize the relationship between hyperparathyroidism and renal calculi, which the authors find to be more often associated than osteitis fibrosa and parathyroid disease. Albright, who in ten years accumulated a series of 67 cases of hyperparathyroidism, found classical osteitis fibrosa cystica in only one-third and maintained that renal involvement was more frequent and its conse-

used intravenously for pyelography, proved relatively non-irritating in the peritoneal cavity and its absorption was rapid and complete. Four or 5 cc is believed to be enough for the average case. The visualization obtained appears from the illustrations to be clear and adequate.

The author claims no originality for the use of skiodan for uterosalpingography, stating that "it is possible that others have used it for the same purpose." [He is correct in this assumption, for Titus, Tafel *et al* reported the use of a skiodan acacia mixture for uterosalpingography as early as 1937 (*Am J Obst & Gynec* 33 164, 1937, *Ibid* 36 889, 1938)]. In their experience, skiodan alone had not sufficient viscosity for this purpose.—[Ed]

PERCY J. DELANO, M.D.

### THE GENITO-URINARY SYSTEM

**Urography in Renal Tuberculosis** Roentgen Diagnostic Investigations Olle Olsson *Acta radiol* suppl 47, pp 1-162, 1943

This monograph concerns renal tuberculosis leading to ulceration, caseation and cavity formation. Other renal lesions, like milary tuberculosis and the chronic fibrosing and disseminated nodular forms, are excluded.

In the introduction it is stated that a diagnosis of renal tuberculosis usually can be made without roentgen examination. Reasons for x-ray examination are (1) the resultant shortening of diagnostic procedure, (2) the possibility of earlier diagnosis, (3) the possibility of diagnosis of closed foci, (4) a differentiation between forms of renal tuberculosis amenable to surgical interference and other types, (5) a desire to have more than circumstantial evidence on which to base a serious surgical decision, though it is emphasized that the diagnosis of renal tuberculosis should not be based on radiologic evidence exclusively.

These questions are proposed for evaluation (1) Are the contrasts obtained sufficient for a study of the anatomy of the renal pelvis? (2) Is it permissible to draw conclusions concerning the extent of the destructive tuberculous process in the renal parenchyma from the density of the contrast shadows obtained in the renal lumina? Thus, the attempt is made to furnish an answer in regard to anatomic and functional criteria on which the diagnosis might be based. From the answer obtained, information was expected as to whether urographic changes could be anticipated in all cases of renal tuberculosis and whether such changes permitted of an etiologic diagnosis.

The study was based upon 89 patients with 173 kidneys, among them 103 tuberculous kidneys observed between June 1, 1933 and December 1942 in the Roentgen Diagnostic Department of the University of Lund, these figures comprising all proved cases of renal tuberculosis seen at this institution in that time. The patients ranged in age from ten to sixty-one years and presented symptoms from one month to five years, though it should be mentioned that 13 were entirely symptomless. Quite a number of these patients stated that they had experienced originally a short period of illness and distress, followed by a long interval, up to several years, of well-being before more protracted recurrent symptoms led to a detailed study. One-third of all patients experienced acute colic-like episodes as their first symptom, easily misleading to a suspicion of urinary calculi.

Technical procedures were standardized as far as possible. The intestinal tract was cleared well on the day preceding the examination, by castor oil and enemas. On the day of the examination, breakfast and material amounts of fluid were omitted, while the examination was scheduled as early in the morning as possible in order to avoid undue accumulation of gas in the intestinal tract. While, in the beginning, uroselectan was used as contrast material, this was soon abandoned for perabrodil, which is now used exclusively. Excluded from the procedure were all patients with a non-protein-nitrogen level exceeding 50 mg. No serious reactions were encountered, but all questionable patients were tested for hypersensitivity by intradermal preliminary injections.

The radiologic procedure was regulated as follows (1) A scout film of the abdomen was obtained. If shadows suspicious of calculi were observed, they were investigated further and localized by additional oblique and lateral films as necessary. (2) The second exposure was obtained 1 to 4 minutes after the intravenous injection and reviewed immediately. (3) Immediately following this exposure, gradual compression was applied to the lower ureters and after this had been in place for 5 minutes, additional films in various numbers were made as considered desirable. (4) After removal of the compression, supplementary views of ureters and bladder, often including various oblique projections, were secured. Postero-anterior projections not infrequently were obtained and found of advantage when ventrally located cavities within the kidneys were to be demonstrated.

A detailed chapter of this monograph deals with urographic diagnostic criteria of renal tuberculosis based on functional observations as follows:

About one quarter of all cases of renal tuberculosis examined presented normal contrast shadows of the renal pelvis. The density of the contrast shadows, therefore, cannot be considered exclusively and by itself as the sole criterion for or against the existence of a tuberculous process. This applies especially to early cases of limited extent.

One-seventh of all tuberculous kidneys failed to give any contrast urograms. These kidneys were involved by advanced disease processes, and 14 of the 16 revealed changes suggestive of disease in the scout films—irregular enlargement, calcific deposits, "putty kidneys"—while only one appeared grossly normal. In these cases urography proved of importance in so far as it gave information concerning the functioning kidney, which is often hard to obtain instrumentally because of severe existing bladder involvement.

Two-thirds of the cases showed varying degrees of functional impairment which was of diagnostic importance in so far as advanced cases generally showed pronounced functional deficiency, while milder degrees of dysfunction generally corresponded to smaller lesions. However, exceptions occurred in both directions, and their significance and possible causes are discussed in some detail. They detract from the value of urography, especially in consideration of bilateral lesions. They emphasize the necessity of evaluation of all available functional and anatomic data.

The next chapter analyzes urographic criteria of renal tuberculosis based on studies of anatomic detail. In order to evaluate roentgenologic possibilities in this respect, the earliest anatomic manifestations of the disease are discussed in contrast to tuberculous bacilluria.

formed until suspected metastases appear and only after these have failed to respond to radiation. In young patients, however, and in those having rapidly growing metastases, surgical treatment is primary, with roentgen therapy postoperatively. In cancer of the oral cavity, the incidence of metastasis is higher and control of the primary lesion is more difficult. In these cases the adjacent nodes are always included in the irradiation of the primary tumor and when malignant involvement is suspected the entire neck region is irradiated. Block dissection is postponed until the radiation reaction has subsided. The nodes may then be dissected if there is a reasonable chance that the primary tumor is curable. If there is no reasonable chance of cure, extensive surgical intervention is contraindicated, with a few exceptions in which it may be done for palliation. In almost all cases, block dissection should be carried out only if there is a high probability that radical dissection can be accomplished.

In the series reported, a total of 113 block dissections were carried out on 104 patients, with an operative mortality of 1.8 per cent. At the time of the report, 43 patients (41.3 per cent) were alive without evidence of recurrence, 50 (48.1 per cent) had died of the cancer, 2 were alive with cancer, and 9 had succumbed to intercurrent disease (a new primary cancer in 4 instances). The author bases his survival rates on the number of patients followed. Thus, of 23 patients with carcinoma of the lip observed for three years, 19 or 82.6 per cent were symptom-free at the end of that period, while of 20 followed for five years, 16 or 80 per cent were without evidence of disease. For cancer of the oral cavity, the survival figures (symptom free) are 38.5 per cent of 39 patients after three years and 33.3 per cent of 30 patients after five years. In the miscellaneous group of "other tumors," the three-year figure is 35.7 per cent of 14 patients and the five-year figure 37.5 per cent of 8 patients. Taking the group as a whole, 51.3 per cent of 39 patients followed for three years were alive and well, and 50 per cent of 29 patients followed for five years.

Of the entire 104 patients, only 1.4 per cent had recurrences at the site of dissection. Histologic diagnosis confirmed the clinical impression of metastasis in 79.7 per cent of 118 cases (including some in which only partial dissection was done), but in the remaining 20.3 per cent no metastases were found.

The anatomical relationships of the cervical lymph nodes are discussed and the surgical procedure for block dissection is described. ELIZABETH A. CLARK, M.D.

#### Treatment of Tumors of the Urinary Bladder Rolf Weyde Acta radiol 26 589-605, Nov 30, 1945

The author's choice of method in the treatment of bladder tumors is electrocoagulation and implantation of radium needles in the base of the tumor followed by roentgen irradiation. He recommends cystotomy for the coagulation and implantation of radium because the tumor can be evaluated more successfully and implantation can be accomplished with greater accuracy. Modifications of the ideal plan of therapy become necessary when the poor general condition of the patient and the extent of the tumor make surgery impractical. Thinness of the bladder wall may contraindicate implantation of radium needles, and the tolerance for radiation may not allow administration of the dose of 5,500 r considered desirable. In young people with papillomas and in small recurrences electrocoagula-

tion through the cystoscope, if the patient can be kept under observation, is considered satisfactory. Resection was possible in a few of the author's cases, and electrocoagulation after response of previously inoperable tumors to radiation in a few others. Tumors which showed atypical cells in otherwise characteristic papillomas in the older age groups were treated as carcinomas because of the tendency to recurrence with frank malignant changes found early in the series.

Of 155 patients with tumors of the urinary bladder, 53 were in such poor condition that not even palliative radiation could be administered. At the time of compilation of statistics, a total of 111 patients had died of their bladder neoplasms and 4 of intercurrent diseases. Of the 39 living patients, 28 were free from recurrence, 11 patients were living free from symptoms for more than five years, and 20 for more than three years. In only 13 patients could the combined method of surgical-radiological treatment, with the insertion of radium needles, be carried out, and this group is considered too small for a reliable expression of results. ELIZABETH A. CLARK, M.D.

#### Salient Factors in the Treatment of Hodgkin's Disease and Lymphosarcoma with Roentgen Rays Arthur U. Desjardins Am J Roentgenol 54 707-722, December 1945

The treatment of Hodgkin's disease and lymphosarcoma is covered in considerable detail and some aspects of clinical recognition and course of the diseases are discussed. It is pointed out that roentgen therapy may be of use in differential diagnosis, especially when the lesions are confined to the mediastinum. In determining the plan of treatment, the areas of maximum involvement should receive first attention. The author prefers to use roentgen rays generated at moderate voltages (130 to 140 kv) and filtered through 4 to 6 mm of aluminum. He believes this quality of radiation is more effective than that produced by higher kilovoltages even for the treatment of mediastinal or abdominal node involvement unless the patient is above the average in size. He has found it more effective to give each field treated, in one or two days, as large a dose of radiation as can be tolerated without harmful effects. This dose usually is between 550 and 600 r (surface dose, measured in air). Different fields are treated successively, one at a time, until all have received the specified dose. The time distribution of treatment is of considerable importance. Intervals between treatment to any single area of as long as a week and the use of too small a dose at each individual treatment are major factors in poor regression of the lesions and the development of early radio-resistance. L. W. PAUL, M.D.

#### Roentgen Treatment for Hodgkin's Disease and Lymphosarcoma of the Chest Arthur U. Desjardins Dis of Chest 11 565-589, November-December 1945

Comment is made on the specific sensitivity of different types of cells. The changes occurring in sensitive cells, such as lymphocytes, after irradiation, are described. The sensitiveness of tumors corresponds closely to that of the cells of which the tumors are chiefly composed. Knowledge of comparative sensitiveness of tissue permits of differential diagnosis following a therapeutic test. Thus a clear distinction can be made between Hodgkin's disease or lymphosarcoma and

quences more important. The present writers reaffirm this. In eighteen months they collected 18 cases of proved hyperparathyroidism. In 4 of these there were associated classical bone changes alone, while 14 of the patients had renal calculi.

Symptoms of hyperparathyroidism vary widely. Constitutional symptoms include general muscular weakness, lassitude, fatigue, and constipation, ascribed to hypercalcemia. Polyuria and polydipsia occur, and the specific gravity of the urine is usually low. In the presence of renal calculi the symptoms are those commonly seen with that condition. Skeletal symptoms consist in vague aching in the bones and joints, pathological fractures, cysts and tumors of bone, and skeletal deformities.

The diagnostic criteria of hyperparathyroidism are hypercalcemia, hypophosphatemia, hypercalciuria, and hypophosphaturia. The serum calcium and phosphorus values fluctuate, however, and one negative examination does not rule out the disease, as subsequent studies may yield positive findings. Hyperparathyroidism should be seriously considered when the serum calcium exceeds 10.5 mg per 100 c.c. With borderline calcium levels, the finding of a low total serum protein may be indicative of hyperparathyroidism. The concentration of alkaline phosphatase in the serum is not increased except in the presence of bone lesions.

In cases of hyperparathyroidism associated with renal calculi a detailed urologic study is indicated. Roentgenologic findings may show only a single stone or there may be long standing calculous disease and diffuse or miliary calcinosis of the renal parenchyma. In the authors' series most of the stones were of calcium oxalate. The treatment is removal of the parathyroid adenoma or hypertrophied tissue, which should usually be done before removing the calculi, to avoid recurrences. Renal emergencies, however, may necessitate handling the urologic problem first.

Hyperparathyroidism should be given due consideration in all cases of renal calculi, especially if recurrent, regardless of the bone findings.

ARTHUR W. PRYDE, M.D.

### THE BLOOD VESSELS

An Attempt at the Roentgenologic Visualization of Coronary Blood Vessels in Man. Stig Radner. *Acta radiol* 26 497-502, Nov 30, 1945.

Angiography of the cerebral vessels and of the heart and great vessels has been accomplished, but opacifica-

tion of the coronary arteries presents a more difficult problem. By puncturing the bulb of the aorta it was found that the coronary arteries could be filled in animals. The author's method in human subjects is puncture of the aorta through the sternum under fluoroscopic control and injection of thorotrast. The procedure was carried out on 5 patients. Faint outlines of the proximal portions of the vessels can be seen in the roentgenograms, although the superimposed shadows of the pulmonary veins complicate interpretation. There were complications in two cases, mediastinal emphysema in one, and extravasation of blood into the pericardium and subsequent exudative pericarditis in the other. Both patients recovered without sequelae.

ELIZABETH A. CLARK, M.D.

Observations on the Technique of Phlebography. Gunnar Bauer. *Acta radiol* 26 577-588, Nov 30, 1945.

Of about 500 phlebographic examinations, 180 were performed because of clinical suspicion of incipient thrombosis in the lower legs. Diodrast was the preferred contrast medium, but Intron (sodium diiodomethane sulfonic acid) was also satisfactory if diluted with physiological saline and followed by injection of saline when pain occurred. Injections were made into the vein behind the lateral malleolus after exposure through a small skin incision, and roentgenograms were taken in anteroposterior and lateral projections. All patients were examined with the leg in horizontal position.

In 73 of the 180 patients examined, no visualization of the deep veins was obtained, and the diagnosis of thrombosis was considered established. In 62 patients the veins were so well filled that they were regarded as normal, but in only 44 of these was opacification perfect. Of the remaining 18 "normal" roentgenograms 10 showed a thin-line filling of one or more segments due to settling of the dye along the dependent surface, 6 showed small defects interpreted as blood from tributary veins, and 2 cases showed combinations of these findings. Of the 45 patients with incomplete filling, which was interpreted as incipient thrombosis, 42 subsequently gave typical clinical evidence of the condition. In 18 of these latter examinations, filling was absent in a long segment of a major trunk, with dilatation of the vein below, in the remaining 27 there were irregular bubble-like rarefactions in the dye-filled vein.

ELIZABETH A. CLARK, M.D.

## RADIOTHERAPY

### MALIGNANT NEOPLASMS

On Radio-Surgery of Tumor Metastases in the Lymph Glands of the Neck. Rolf Bull Engelstad. *Acta radiol* 26 555-576, Nov 30, 1945.

Since there is wide variation in the method of treatment of cervical lymph node metastases and since clinical diagnosis of metastasis is uncertain, the author presents a series treated at the Norwegian Radium Hospital from 1923 to 1944 and advocates the combination of block dissection and radiation therapy in selected cases. Among malignant tumors which metastasize to the cervical nodes, carcinoma of the lip and

oral cavity are the most important, cancers of the tonsils, pharynx, larynx, salivary glands, nose, sinuses and skin produce metastases less commonly. These latter, grouped together under the heading "other tumors," usually present problems of more importance than the cervical metastases and are considered only under special circumstances for the type of therapy described.

The author bases indications for block dissection first on prognosis. Since the incidence of metastasis from carcinoma of the lip is moderate and the primary lesion can usually be controlled, the patient is kept under careful observation and block dissection is not per-

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## Eosinophilic Granuloma of Bone<sup>1</sup>

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Cleveland, Ohio

A peculiar destructive granulomatous lesion of bone was first recognized and described independently in 1940 by Otani and Ehrlich (18) and Lichtenstein and Jaffe (14). Lesions of similar type had previously been described by Finzi (6) in 1929, Mignon (16) in 1930, and Scharrer (21) in 1938. They did not, however, consider the lesion to be a distinct entity and referred to it as myeloma with prevalence of eosinophils, granulation tumor of bone, and osteomyelitis with eosinophilic reaction, respectively. Lichtenstein and Jaffe's denomination, "eosinophilic granuloma of bone," has been widely accepted. Up to July 1, 1945, 48 acceptable cases were recorded in the literature. To these are added the 5 reported in this paper, making a total of 53 published cases.

### ETIOLOGY

The cause of eosinophilic granuloma of bone is as yet unknown. Trauma has been considered significant, but proof of a causative relationship is lacking in most instances. Ziehl-Neelsen stains and guinea-pig inoculation of material from the lesions have failed to demonstrate tubercle bacilli. Other bacteriological examinations have shown no organism to be present with any degree of frequency. At the present time most authors consider the lesion to be of

inflammatory type, but a causative organism has not been demonstrated.

### SEX AND AGE OF PATIENTS

Of the 53 cases which are reported in the literature (including the present series), 36 were in males and 7 were in females, in 10 cases the sex was not indicated.

The incidence with respect to age at the time when the diagnosis was established by operation or autopsy is shown in Table I.

TABLE I AGE INCIDENCE

Less than 10 years	20 (37.7%)
10 to 19 years	14 (26.4%)
20 to 29 years	7 (13.2%)
30 to 39 years	3 (5.7%)
40 to 49 years	0
50 to 59 years	2 (3.8%)
Age not stated	7 (13.2%)

The youngest patient was a six-month-old boy, the oldest a fifty-eight-year-old man. As indicated in the tabulation, eosinophilic granuloma is more common in the younger age group, 64 per cent of the cases occurring in those less than twenty years of age. Although most common in childhood, the condition is not limited to children and young adults.

### LOCATION OF LESIONS

In the great majority of instances the lesions are confined to bone. Neverthe-

<sup>1</sup> From the Departments of Roentgenology, Medicine, and Pathology of Western Reserve University, Institute of Pathology, and University Hospitals of Cleveland. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

an aortic aneurysm, carcinoma of a bronchus, neurofibroma, fibrosarcoma, teratoma, or a tuberculous adenitis

Hodgkin's disease and lymphosarcoma, clinically, are essentially the same. They are members of the same family. They can start, develop, and invade from and to the same places in precisely the same manner and at the same rate. They are also influenced by a given dose of x-rays in about the same manner and at the same rate. In most cases where mediastinal nodes are invaded, the involvement is secondary to lymph node disease in other regions. When axillary nodes are invaded, mediastinal nodes are usually involved. Also, when inguinal nodes are invaded, the retro-abdominal nodes are involved.

Hodgkin's disease and lymphosarcoma are composed largely of hyperplastic lymphoid cells and are very sensitive to roentgen rays. In the majority of cases, an intrathoracic lymphoblastomatous mass can be expected to shrink 30 to 100 per cent within three to four weeks after a well planned course of treatment. The author treats through two large anterior and two corresponding posterior fields. Each anterior port extends from the suprasternal notch to the ensiform cartilage, and from the mid-line to the anterior axillary line. The central rays converge through each port at an angle of 30 to 40°, being directed to the central part of the chest. Treatment is also given through two additional fields, directed to the mediastinum through the thoracic inlet, including the neck, if nodes in the upper part of the chest are involved. When retro-abdominal nodes are involved, additional treatment is directed toward the upper half of the abdomen through two anterior and two posterior fields, or toward the entire abdomen through four anterior and four posterior fields.

The author has observed better results with intermediate than with deep therapy. He prefers 130 or 140 kv with 6 mm Al filtration and 550 r to each field in one or two days, to 200 kv and 600 r to each field in three to six days. He feels it is wise to repeat the same dosage in three weeks, even if there appears to be 100 per cent regression of the involved nodes, unless there is a marked reduction in the white count. The regression and improvement last longer after two courses of therapy. It may be necessary to give three courses, then the interval between the second and third courses should be lengthened to five or six weeks.

HENRY K. TAYLOR, M D

**A Review of the Problem of Cancer of the Cervix Since the Use of Radium in 1912** Brooke M. Anspach. *Am J Obst & Gynec* 50: 681-690, December 1945.

In 1911 Wertheim was obtaining an 18.4 per cent five-year absolute survival rate following operation for the removal of cancer of the cervix in patients in whom his percentage of operability was 50. Kelly and Burnam began an epoch in 1913 by adopting radium as the treatment of choice. Ever since, gamma rays have been a large factor in the treatment of cancer and to a considerable extent have taken the place of radical surgery.

Anspach discusses the present means of finding the early cases of cervical cancer and the danger of promiscuous use of hormones near the menopause, which may prolong the "delay period" before the diagnosis is established. The color test of Schiller colposcopy, and vaginal smear methods direct attention to suspected cases, but biopsy or diagnostic curettage remains the trustworthy criterion.

In irradiation the lesion must be studied as to exact position and extent. "The acme of radium application is achieved only when a sufficient supply of radium salt or its emanation suitably screened is at hand at the moment of application." The dose is 3,600 mg hr and upwards. A "massive dose" at the first treatment has been the trend for a long while. Heyman and others believe in smaller repeated applications. Alpha and beta rays are excluded by platinum capsule walls of 1.0 mm thickness or 2.8 mm of lead, when the content is 50 mg of radium salt. For 10 mg needles, 0.3-mm. platinum or 0.63-mm solid gold walls are satisfactory.

Theoretically, deep x-ray therapy should precede radium application, since manipulation incident to radium application may displace cancer cells not previously exposed to deep x-ray. The standard treatment used by the author consists of 1,600-2,400 r given through four ports. A transvaginal port exposure of the same dose has been added since 1944.

Bonney succeeds Wertheim as the outstanding exponent of radical surgery and in 1941 reported his absolute five-year salvage in 500 operations as 23 or 20 per cent.

Lynch, comparing irradiation and an advanced radical operation in a selected group with irradiation alone, favored definitely the combination of irradiation and operation. For example, in the ten-year estimate, the salvage rate of the combination was 62.9 per cent, and of irradiation alone, 36.7 per cent.

In summary the author states that a greater number of cancer patients are presenting themselves in an early stage, that irradiation will become more widely and adequately available, and more effectual, that operative risk has been reduced and improvement is likely to continue, that a combination of irradiation and operation will perhaps give better results.

RUSSELL WICH, M D

**Extragenital Chorionepithelioma in the Male** Hyman M. Chernoff, Theodore S. Evans, and Charles J. Bartlett. *Arch Int Med* 76: 347-351, November-December 1945.

A case of extragenital chorionepithelioma in a 30-year-old male is recorded. The clinical picture of gynecomastia pain in the lumbar region, hemoptysis, loss of weight, and rapid downhill course in this patient is characteristic of tumors of embryonal urogenital origin which have metastasized widely. Intensive roentgen therapy over a period of five months did not alter the outcome although it did produce some symptomatic relief and some decrease in the size of the pulmonary metastases.



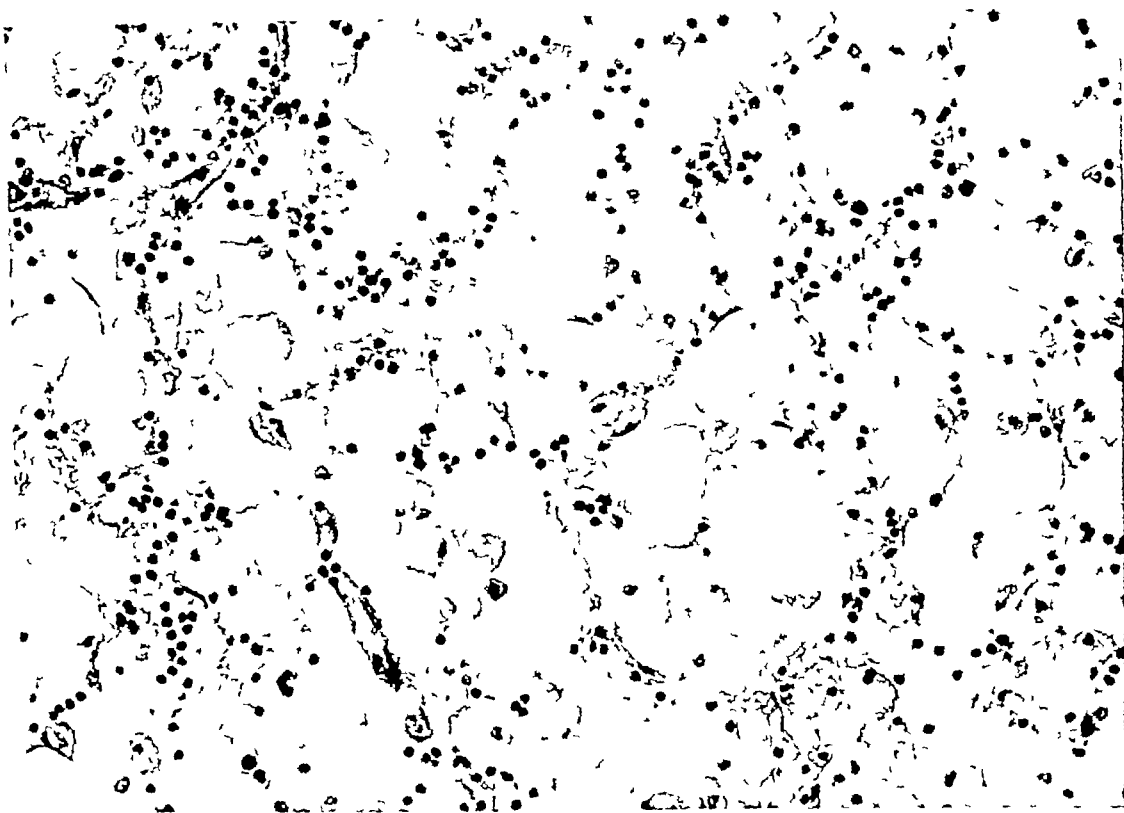


Fig 1 Case 1 Photomicrograph showing numerous mononuclear "foam" cells and a few lymphocytes  
Hematoxylin and eosin  $\times 312$

The microscopic picture varies in different stages. According to Farber (5), the variations represent stages in evolution of the lesion. In the early destructive (cystic) stage there are foci of necrosis and hemorrhage and a large number of cells. The cells include eosinophilic leukocytes and myelocytes, large mononuclear cells (histiocytes) with granular cytoplasm, lymphocytes, plasma cells, neutrophilic leukocytes, and phagocytic multinucleated giant cells. In the intermediary stage the mononuclear cells have vacuolated (foamy) cytoplasm and eosinophils are few in number or absent. In the late stage there is proliferation of connective tissue and eventually regeneration of bone.

Although at one stage the eosinophil is the predominant and most conspicuous cell, the mononuclear histiocyte (foam cell) is considered the characteristic cell. The presence of these "foam" cells in large numbers has resulted in speculation as

to a relationship between eosinophilic granuloma, Letterer-Siwe, and Schuller-Christian's disease. It has been suggested that these three conditions may be the result of an unknown infectious agent, eosinophilic granuloma being the most benign and localized form, limited to bone. The possibility of such a relationship is suggested by (a) the similarity of microscopic pictures of all three conditions, (b) the development of lesions with the microscopic picture of eosinophilic granuloma in proved cases of Schuller-Christian's disease, (c) the occurrence of extra-osseous lesions in instances of eosinophilic granuloma of bone (e.g., in Case 3 of this paper, with involvement of sternum and lymph node).

#### PROGNOSIS AND TREATMENT

The disease ordinarily runs a course of a few months to a year or more. With or without treatment, the prognosis is usually

less, a few instances (15, 22) of extra-osseous eosinophilic granuloma, of which Case 3 in this paper is an example, have been described

The osseous lesions are usually solitary and involve the bones of the skull or pelvis, the vertebrae, ribs, and long bones. Multiple lesions are, however, not uncommon. The greatest number of lesions in a single case was 25. The lesions were solitary in 36 and multiple in 10 of the 53 recorded cases. In 7 cases the number of bones involved was not stated.

The location of 108 lesions in 46 cases adequately reported with respect to this feature is indicated in Table II.

TABLE II LOCATION OF LESIONS

	36 Cases with Solitary Lesions		10 Cases with Multiple Lesions	
	Number	Per Cent	Number	Per Cent
Skull	13	36.0	8	11.0
Ribs	6	16.6	24	33.3
Femur	6	16.6	7	9.8
Pelvis	2	5.5	5	7.0
Humerus	2	5.5	7	9.8
Tibia	2	5.5	2	2.8
Radius	1	2.8	0	0
Sternum	1	2.8	0	0
Scapula	1	2.8	2	2.8
Clavicle	1	2.8	0	0
Mandible	1	2.8	4	5.5
Fibula	0	0	2	2.8
Vertebrae	0	0	9	12.5
Face	0	0	2	2.8
TOTAL	36	99.7	72	100.0

### SIGNS AND SYMPTOMS

Local and systemic signs and symptoms of slight to moderate degree are present in most instances. Occasionally, however, as in 2 of the present series of 5 cases, the lesions remain quiescent, produce no symptoms, and are discovered only at autopsy. When multiple lesions are present, only one, or a few of them, may give rise to signs or symptoms.

The most common symptoms are pain, swelling of the soft tissues, and tenderness at the site of the lesion. The pain, which varies from slight to severe, may have a duration of a few days to several months. Soft-tissue masses 2 to 4 cm in diameter

may develop over the osseous lesions. Other local signs are muscular spasm and atrophy.

There may be systemic manifestations, including slight fever, anorexia, easy fatigability, headache, and loss of weight. Leukocytosis of slight degree and eosinophilia (4 to 11 per cent) are sometimes noted. The blood sedimentation rate may be increased. Bone-marrow biopsies frequently reveal an increased number of eosinophils. Blood chemical determinations, including cholesterol, are characteristically normal.

### ROENTGENOLOGIC FEATURES

X-ray examination reveals a round, oval, or irregularly shaped area of decreased density sharply demarcated from adjacent normal bone. The lesions usually vary from 1 to 4 cm in diameter. There is no osteoporosis of surrounding bone. Sclerosis of the margins of the lesion has been mentioned in two previous reports and occurred in one of the cases reported in this paper (Case 4, Fig 11). Periosteal thickening of long bones was noted in 2 cases reported in this paper and in 12 of those previously recorded. Soft tissue swelling is common in eosinophilic granulomas of the skull and not uncommon in those of ribs and vertebrae. The lesions apparently originate in the medullary portion of the bone. As the lesion grows, the cortex may be decreased in thickness, sometimes perforated, occasionally expanded. Spontaneous pathologic fractures may result at the site of the granuloma (23).

### MORPHOLOGY GROSS AND MICROSCOPIC

In the early stage the lesion is characteristically cystic and hemorrhagic. The cysts vary from less than one to several centimeters in diameter and contain soft, friable, yellowish-brown and red material. The yellow color is due to necrosis or lipid, the red to hemorrhage. In later stages the cysts are replaced by friable pale yellow tissue (rich in lipid) that is softer than adjacent bone. With healing there is replacement by gray connective tissue and finally bone formation.

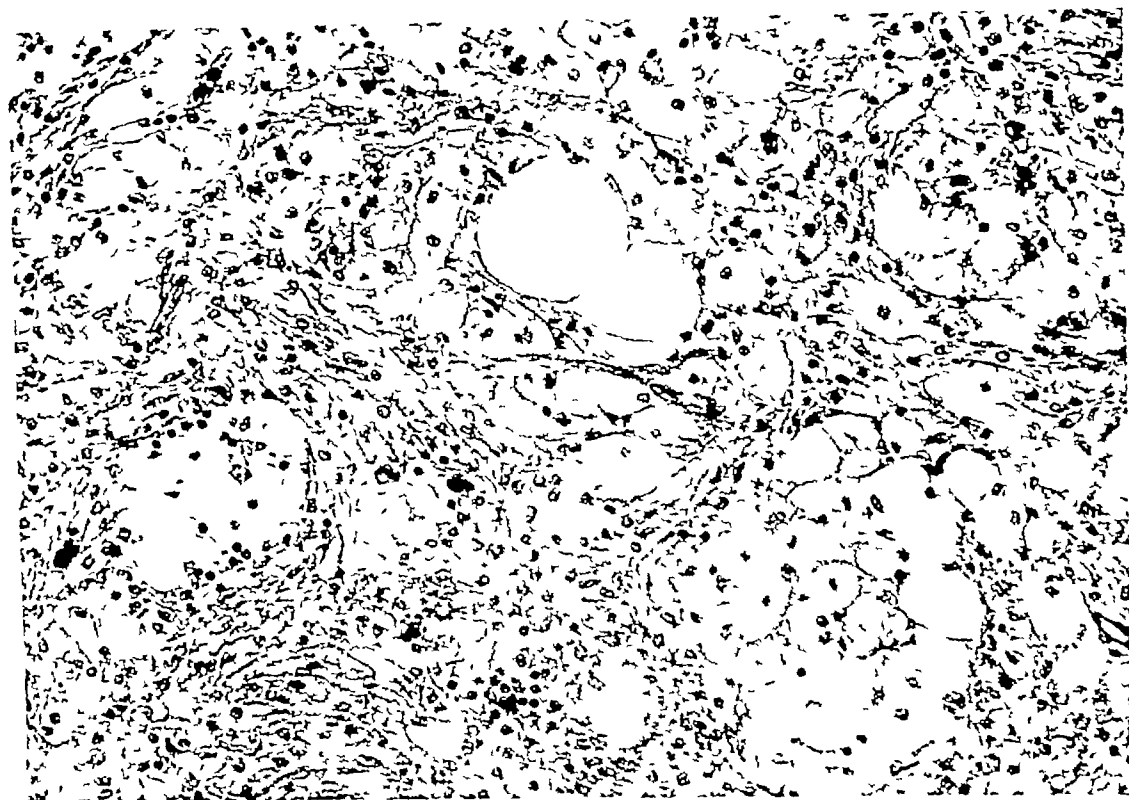


Fig 3 Case 2 Photomicrograph showing numerous mononuclear "foam" cells and a moderate amount of collagenous connective tissue Hematoxylin and eosin  $\times 312$

*Autopsy* (8118, by O Eitzen, M D) revealed bronchopneumonia as the immediate cause of death. Sections of many lesions from various bones showed the characteristic picture of plasma-cell myeloma. The largest lesion, situated in the right humerus (Fig 2), had the gross and microscopic features of the intermediate stage of eosinophilic granuloma of bone. The tissue was soft, friable, and dark yellow. Large mononuclear cells with vacuolated (foamy) cytoplasm were abundant, and a moderate amount of collagenous connective tissue was present (Fig 3). There were no plasma cells or eosinophils in this lesion.

**CASE 3** A 17-year-old white female had "a tender lump on the chest." She was admitted to the hospital on Dec 27, 1943, six weeks after the sternal mass was first noticed. She complained, also, of slight but definite and unusual tiredness. The sternal lesion had been painful continuously for two days before admission to the hospital.

The patient was well developed and well nourished. Her temperature was  $37.4^{\circ}\text{C}$ . There was a firm, rubbery, moderately tender mass at the junction of the right third costal cartilage and sternum. This had a maximum measurement of 5 cm and was elevated 7 to 8 mm above adjacent tissue. Several small, discrete, firm, non-tender lymph nodes were

palpated superior to the medial portion of the left clavicle.

The laboratory findings were as follows: 7,400 white blood cells (3 per cent eosinophils), 3,870,000 red blood cells, hemoglobin 72 per cent (Sahl), sedimentation rate 12 cm. per min., serum calcium 9.5 mg per 100 c.c., serum phosphorus 2.7 mg per 100 c.c., serum alkaline phosphatase 10.8 Bodansky units, Kline exclusion test negative.

A postero-anterior chest film (Fig 4) showed the mediastinum to be widened, measuring 7 cm. In the lateral view of the chest the mediastinal mass appeared along the posterior margin of the sternum. Along the anterior aspect many layers of periosteal new bone formation were evident (Fig 5). An oval area of destruction, measuring  $5 \times 3$  cm., appeared in the right side of the upper half of the gladiolus on oblique laminagrams (Fig 6). The edges of this lesion were poorly defined and there was no evidence of sclerosis.

A biopsy was performed on Dec 28, 1943. The sternal mass consisted of soft, friable, yellowish-gray tissue. The surgeon considered it to be a tuberculous lesion with caseation necrosis. Microscopic examination showed a richly cellular lesion with small foci of necrosis (Fig 7). Eosinophilic and neutrophilic leukocytes were abundant. There were also many lymphocytes, large mononuclear

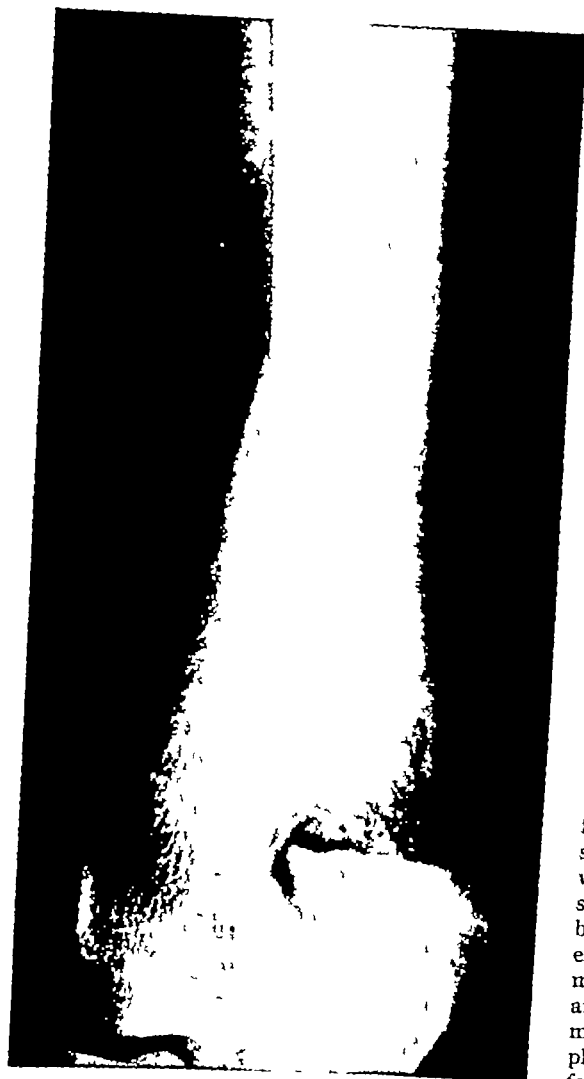


Fig 2 Case 2 Right humerus, showing oval area of decreased density in the lower portion of the shaft

good, particularly in cases with solitary lesions

Treatment in the cases reported has consisted of surgical excision, curettage, and irradiation. All three have been effective and apparently relieved symptoms and hastened the disappearance of the soft-tissue swelling and the osseous lesion.

The total dose of radiation has varied from 400 to 500 r (air) to 1,200 to 1,800 r (air). Although the most effective dose and rate of administration have not been determined, radiation is usually given in

divided doses of 200 to 300 r daily or even monthly. It seems definite that most cases respond to this type of treatment. Lesions of the skull so treated have shown complete healing in from five to nineteen months.

Because the x-ray appearance of eosinophilic granuloma may be indistinguishable from other inflammatory lesions, multiple myeloma, or metastatic tumor, a biopsy is usually indicated. Thus, in most cases the treatment of choice is probably either complete curettage or curettage followed by irradiation.

#### CASE REPORTS

**CASE 1** A white female, 36 years of age, was admitted to the hospital complaining of cough, nausea, and vomiting. She had been well until one year prior to hospitalization, at which time she was seen by a physician after she had fainted. Examination revealed the murmurs of mitral and aortic stenosis. Several months later she first noticed a persistent cough. At the time of admission she had signs and symptoms of cardiac failure. She died on her fourth hospital day.

*Autopsy* (8027, by F R Dutra, M D) confirmed the diagnosis of rheumatic heart disease and cardiac failure. An unexpected lesion was found in the left sphenoid bone, lateral to the sphenoid sinus. This was 2 cm in maximum measurement, irregular in shape, sharply circumscribed, softer than adjacent bone, and yellowish orange in color. Microscopic examination (Fig 1) revealed a large number of mononuclear cells, some lymphocytes, and a small amount of collagenous connective tissue. The mononuclear cells had abundant vacuolated acidophilic cytoplasm and small nuclei. Eosinophils, foci of necrosis, and hemorrhage were absent. The microscopic picture was considered to be typical of the intermediate stage of eosinophilic granuloma.

**CASE 2** A white male, aged 58 years, was admitted to University Hospitals of Cleveland, Ohio, on Dec. 7, 1942, complaining of weakness for the previous six to eight weeks. While he was in the hospital, fever, weakness, and generalized aching were the most prominent symptoms. Severe anemia and albuminuria were also noted. The differential blood count showed 2 to 4 per cent eosinophils on many occasions. Roentgenograms of the extremities and pelvis revealed many circular punched-out areas of decreased density, 2 to 4 mm in diameter. One area of decreased density (Fig 2) was larger and more sharply defined than the others. This lesion was in the lower portion of the shaft of the right humerus and measured 12 × 10 mm. A sternal biopsy was considered diagnostic of plasma cell myeloma. The patient died on the 143d hospital day.

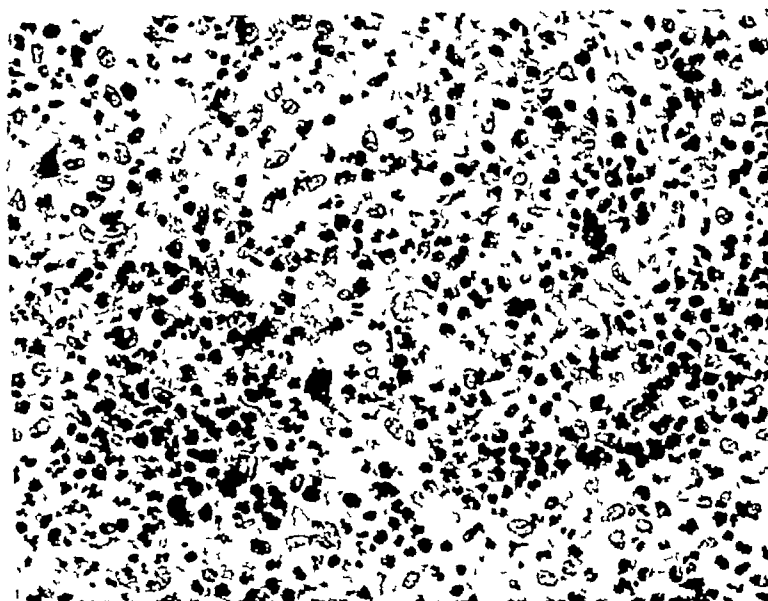


Fig 7 Case 3 Section of tissue from sternal lesion showing numerous eosinophils, large mononuclear cells, and atypical multinucleated giant cells Hematoxylin and eosin  $\times 298$

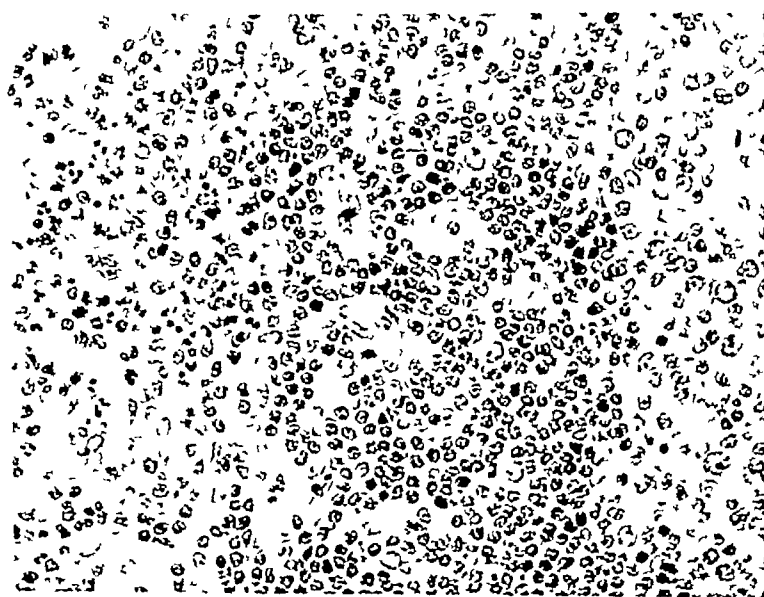
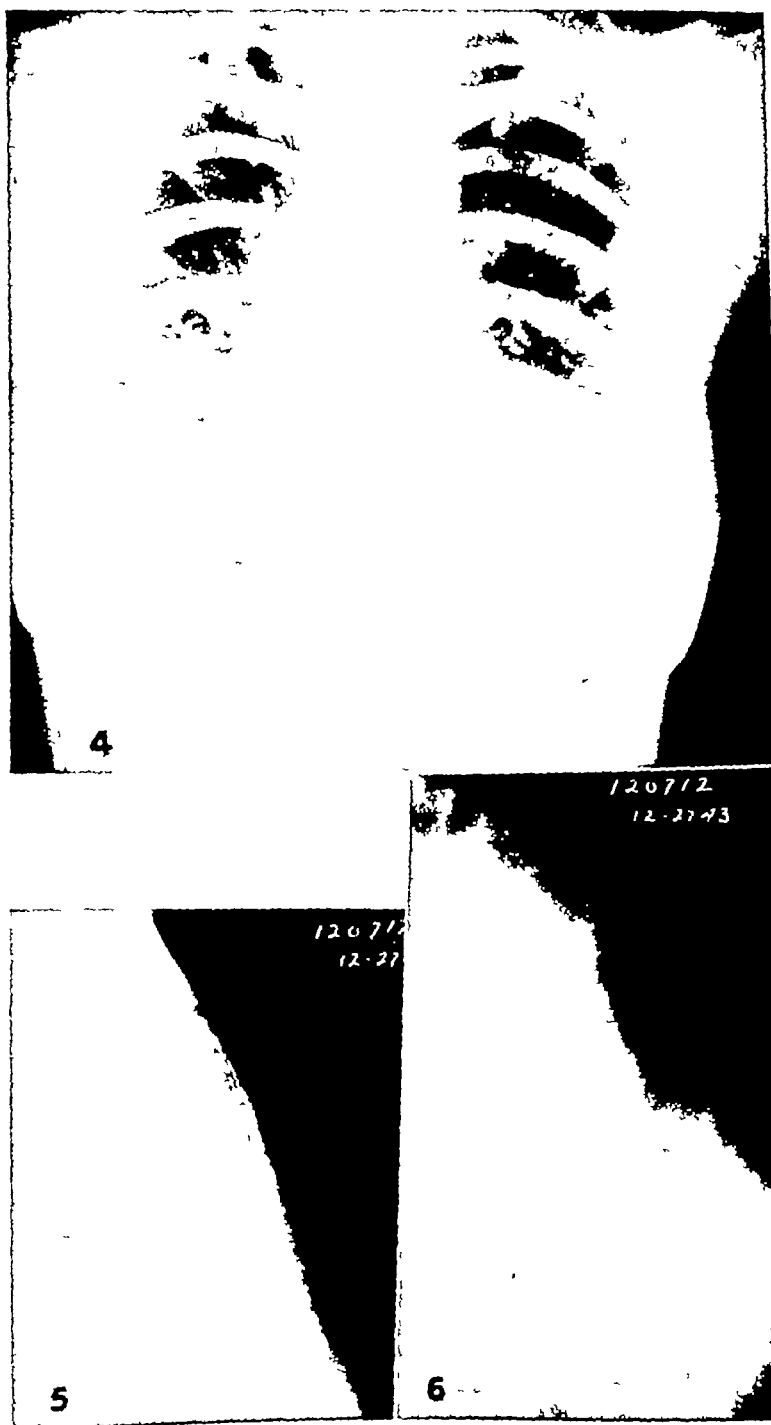


Fig 8 Case 3 Section of axillary lymph node, illustrating normal lymphoid tissue, eosinophils, mononuclear and multinuclear cells Hematoxylin and eosin  $\times 298$

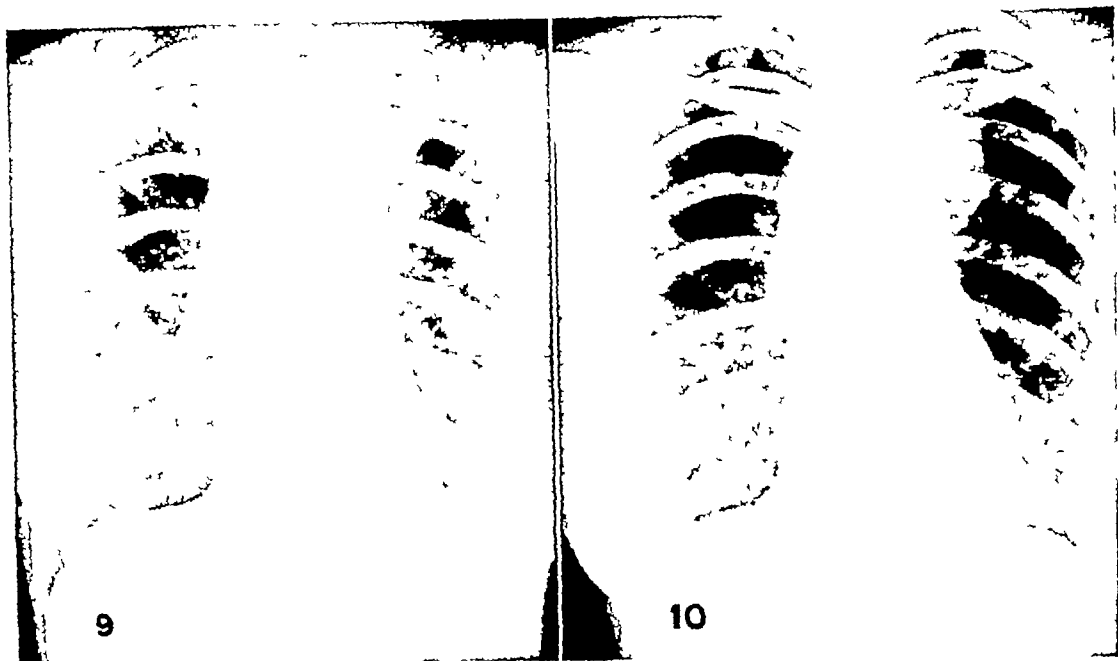


Figs 4-6 Case 3

Fig 4 Postero-anterior chest film of Dec 27, 1943, showing abnormal shadows along the right side of the superior mediastinum. The width of the mediastinum is 7 cm. The lateral chest film showed the mass near the inner table of the sternum.

Fig 5 A lateral view showing several layers of periosteal new bone along the anterior cortex of the sternum. The inner cortex is also thickened.

Fig 6 Laminagram made in December 1943, showing a 5 X 3 cm destructive lesion of the right side of the upper half of the gladiolus of the sternum. The margins of the bone defect are poorly defined. There is no sclerosis.



Figs 9 and 10 Case 3

Fig 9 Postero-anterior chest film made in January 1945 The mediastinal mass measures 12.4 cm in width and 14.0 cm in length

Fig 10 Postero-anterior chest film of September 1945, showing marked enlargement of the mediastinum above the aortic knob The mass was 11 cm in its transverse diameter Lateral chest films showed the shadows to extend to the upper pole of the hilum of the left lung They probably represent enlarged lymph nodes

cells, and spindle-shaped fibroblasts Multinuclear giant cells with large and vesicular nuclei were also present The unusually large number of eosinophils, the features of the giant cells, and the variety of cells were against a diagnosis of Hodgkin's disease The microscopic features were those of the destructive stage of eosinophilic granuloma of bone

The patient was discharged from the hospital after receiving irradiation therapy One 10-cm circular anterior chest field was used The physical factors were 220 kv, filter 0.5 mm. Cu plus 1.0 mm Al, the HVL was 1.2 mm Cu The daily dose was 200 r and the total dose 1,600 r (air)

Another biopsy was performed on Feb 11, 1944, two weeks after completion of the irradiation therapy The microscopic picture was that of a less cellular and more fibrous lesion Most of the specimen consisted of dense fibrous and in part hyalinized connective tissue, in which there were a moderate number of lymphocytes, large mononuclear and plasma cells There were no eosinophils

The patient returned for observation at the end of five weeks At that time the mediastinal shadow had decreased in size from 7 to 6.4 cm.

**First Recurrence** In May 1944, after being symptom-free for three months, the patient again noticed unusual malaise At this time roentgenograms showed a mass along the left side of the sternum at the level of the aortic knob This region was treated with high-voltage irradiation A dose

of 1,600 r (air) was administered to a 10 × 8-cm anterior chest portal The physical factors were the same as in the previous treatment Improvement followed, and the patient was able to work for several months

**Second Recurrence** Anorexia was experienced in October 1944 The patient became weak and stated that she felt she "had the flu" She had a non-productive cough and from October to December 1944 she lost 18 pounds She was readmitted to the hospital at this time and was found to have an afternoon elevation of temperature (38° to 38.4° C) Examination of the peripheral blood showed 10,000 white cells (neutrophils 73 per cent, lymphocytes 13 per cent, monocytes 6 per cent, eosinophils 3 per cent), 5,800,000 red cells, and hemoglobin 60 per cent (Sahli) Chest films showed a marked increase in the size of the mediastinal mass (Fig 9) It measured 12.4 cm. in width at the level of the aortic knob and 14 cm in length The area of bone destruction in the sternum persisted without evidence of healing A second focus of bone destruction, 2 cm in diameter, was observed in the lower half of the gladiolus The left supraclavicular lymph nodes were only slightly, if at all, larger than on the original examination (December 1943) A large, firm, non-tender nodule, measuring 6 cm. in diameter, was present in the right axilla. This was removed on Jan 24, 1945 It was an enlarged lymph node with an intact capsule and unusually soft, pale







Figs 11-13 Case 4

Fig 11 Anteroposterior view of the left femur made April 6, 1945, ten weeks after the first symptoms. The destructive lesion of the femur measures  $3.5 \times 2.5 \times 2.0$  cm. There is mild peripheral sclerosis. Periosteal reaction appears along the medial margin of the femur.

Fig 12 Photomicrograph illustrating focal necrosis (on left), proliferated collagenous connective tissue with many lymphocytes and eosinophils. Hematoxylin and eosin  $\times 250$ .

Fig 13 The lesion of the left femur shows peripheral healing five months after curettage and phenol cauterization. It measured  $3 \times 2.5$  cm on Oct 26, 1945.

yellow, friable tissue. Microscopic examination showed destruction of the architectural pattern in most regions. There were, however, a few recognizable lymph follicles with large secondary centers. The capsule was slightly increased in thickness. There were many foci of necrosis and moderate infiltration with neutrophilic leukocytes. Fibrosis and hyalinization were marked. Eosinophils and large mononuclear cells were also numerous and there were a few multinucleated giant cells (Fig 8). Sections stained with Sudan IV showed many cells containing sudanotropic droplets. A diagnosis of eosinophilic granuloma of lymph node was made.

Additional irradiation was started on Jan 27, 1945. Two 10 × 12-cm anterior mediastinal fields were used, 300 r being given daily for seven days. The total dose was 2,100 r (air) to each field. The physical factors were 400 kv, 1.0 mm Sn plus 0.25 mm Cu plus 1.0 mm Al filtration. The HVL of the beam of irradiation was 4.6 mm. Cu. The left supraclavicular lymph nodes were treated through a circular field, 7 cm in diameter, 200 r daily for eight days, with the 220-kv apparatus used for the first course of therapy given in January 1944. This extensive treatment resulted in severe prostration. The fever had disappeared by the time irradiation was completed.

During the next six weeks the patient gained 10 pounds in weight. Her appetite improved and she "felt fine" for the first time in eighteen months. Roentgenograms showed a decrease in the size of the mediastinal mass from 12.5 cm. in January 1945 to 7.5 cm. in March 1945.

**Third Recurrence.** The patient returned for examination in September 1945. During the preceding few months she had noticed moderate lassitude. There had been no recurrence of fever and no weight loss. The mediastinal mass was found to have increased in size. It measured 11 cm. at the level of the aortic knob (Fig 10). Lateral views showed abnormal shadows extending from the anterior chest wall to the hila of the lungs. One of these shadows, also visible in the postero-anterior view, was thought to be an enlarged lymph node (Fig 10).

Radiation was administered from the back through two portals (12 × 10 cm) parallel to the vertebral column, directed obliquely toward the mediastinum. A dose of 2,000 r (air) was given to each portal during a period of ten days. A slightly enlarged left supraclavicular lymph node was treated with 900 r (air).

The patient was able to go to college and felt fairly well two months after this course of therapy. On Nov 8, 1945, the mediastinal mass had a maximum measurement of 7 cm. Laminaograms of the sternum showed the lesion in the gladiolus to measure 3.5 × 2 cm, with some evidence of peripheral healing.

There was slight increase in the width of the mediastinal mass during the next two months, but no change occurred from January to March 1946.

Mild symptoms of lassitude and weakness developed during this period but no treatment was given. The patient was able to attend college classes at this time (March 1946).

**CASE 4.** A white woman, aged 37 years, was admitted to University Hospitals on April 5, 1945, because of pain and swelling of the left thigh just proximal to the knee. The symptoms were first noted after she bumped her leg in January 1945. Subsequently she experienced periodic pain of increasing intensity on several occasions.

The patient was normally developed and nourished. Her temperature, at the time of hospitalization, was 37.3° C. There was slight tenderness on the anterolateral aspect and lower end of the left femur.

The Kline exclusion test was negative. The serum calcium, phosphorus, and alkaline phosphatase were all normal. The red cell count was 5,160,000, white cell count 7,350, with a normal differential count, with 1 per cent eosinophils. Roentgenograms showed an area of decreased density 6 cm. above the knee joint, in the anterolateral aspect of the left femur (Fig 11). This lesion measured 3.5 × 2.5 cm. The margin of the defect was moderately sclerotic. The overlying periosteum was thickened, measuring 3 to 4 mm. The patient was operated on and a "smooth bulge," 4 cm. in length, was found on the medial aspect of the femur. The compact bone was hyperemic but firm. At this site the cortex of the bone was 3 mm. in thickness. In the adjacent bone was a cavity measuring 3.5 × 3.0 × 2.5 cm., in which there was soft friable reddish-brown material. The walls of the cavity were definitely sclerotic. The cavity was thoroughly curetted and swabbed with crude phenol and alcohol and lavaged with normal saline.

Microscopic examination revealed a richly cellular lesion with multiple small foci of necrosis. Fibroblasts and capillaries were numerous and there was moderate fibrosis. Eosinophils, lymphocytes, and large mononuclear cells were abundant (Fig 12). This was considered to be the destructive stage of eosinophilic granuloma of bone.

Subsequent to treatment, serial roentgenograms have shown slow healing at the periphery of the lesion. In October 1945, five months after treatment, the lesion measured 3.0 × 2.5 cm. (Fig 13).

**CASE 5.** A 4-year-old white boy first experienced "night pain" in his right leg in February 1945. He began to limp one month later. He was seen by a physician in April 1945, at which time a mass 3 × 4 cm. was present in the right iliac fossa. Roentgenograms showed an irregular area of bone destruction in the right ilium, measuring 4.5 × 3.5 cm. The borders of the defect were irregular in contour and it was not sharply defined (Fig 14). The possibility of endothelial myeloma (Ewing) was suggested.

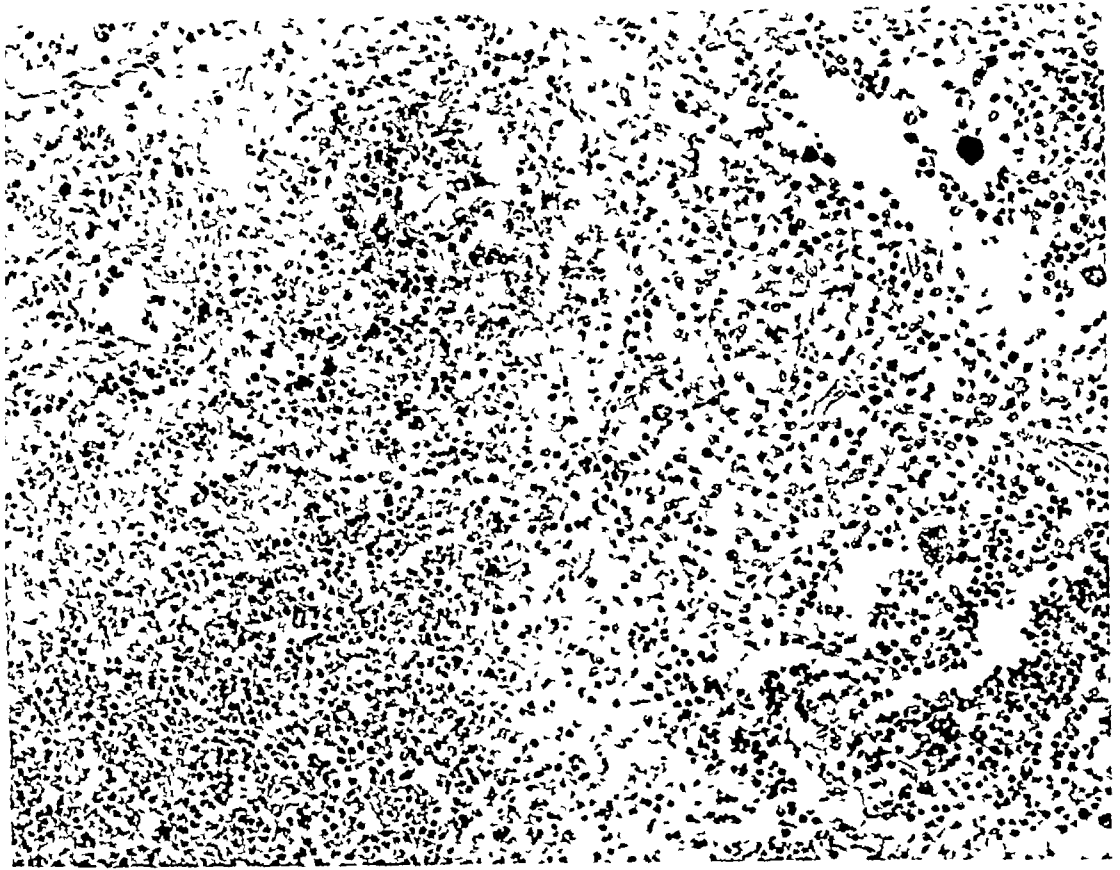


Fig 16 Case 5 Photomicrograph of sections made from tissue removed from lesion of ilium. Numerous cells are present, including eosinophils, lymphocytes, and multinucleated giant cells. Necrosis is evident on the left. Hematoxylin and eosin.  $\times 6175$

systemic symptoms of fever, anorexia, lassitude, headache, and weight loss. Laboratory examination showed no abnormality other than slight leukocytosis and occasionally eosinophilia of 4 to 11 per cent. Roentgenographic examinations showed round, oval, or irregular areas of decreased density, usually 1 to 4 cm in diameter. The lesions produced expansion of the bone in 5 cases and perforation of the cortex in at least 5 cases. Periostitis was observed in 14 cases and 3 lesions had sclerotic margins.

The early lesions appear cystic at gross examination, containing soft, friable, yellowish-brown and red material. A variety of cells, including large numbers of eosinophils, are seen on microscopic examination, but the characteristic cell is a large mononuclear cell with granular cytoplasm. The mononuclear cells have vacuolated

cytoplasm in intermediate stages of the disease and their appearance has been considered as indicating a relationship between eosinophilic granuloma, Letterer-Siwe disease, and Schüller-Christian's disease. Jaffe and Lichtenstein have suggested that the three conditions may be due to an unknown infectious agent, eosinophilic granuloma being the most benign and localized form and limited to bone. Case 3 of the present series may represent a transition from eosinophilic granuloma to Letterer-Siwe disease, since there was lymph node involvement in addition to a lesion of the sternum.

Treatment by surgical excision, curettage, or irradiation has given good results in all previously reported cases. No death from the disease or attributable to the disease has been reported. Case 3 of the present series differs from others recorded



Fig 14 Case 5 Oblique view of the right side of the pelvis made April 24, 1945, showing a destructive lesion  $4.5 \times 3.5$  cm. The margin of the bone defect is irregular in outline and poorly defined in some areas.

The patient was admitted to Babies and Childrens Hospital in April 1945. His temperature on admission was  $37.3^{\circ}\text{C}$  but rose to  $40^{\circ}\text{C}$  or above each day. The white blood cell count was 10,400, with 1 per cent eosinophils.

A biopsy was done on May 1, 1945. Soft, friable, pinkish-yellow tissue was removed. Microscopic examination showed foci of necrosis, large mononuclear cells, abundance of eosinophils, and multinucleated giant cells which were considered to be characteristic of the destructive stage of eosinophilic granuloma of bone (Fig 16).

The lesion was curetted on May 6, 1945. Serial roentgenograms have shown rapid healing. The osseous defect measured  $2 \times 1.5$  cm on Oct 22, 1945 (Fig 15).

#### SUMMARY

Forty-eight cases of eosinophilic granuloma of bone have been collected from the literature and analyzed. Five new cases are reported, making a total of 53 cases.

The sex of the patients was recorded in 43 instances, 36 were males and 7 were females. The age range was six months to

fifty-eight years. Thirty-four of the patients were under twenty years of age and 20 were under ten years.

Nearly all bones proximal to the wrists and ankles were involved. Thirty-six patients had single lesions and in these the skull was involved in 36 per cent, and ribs



Fig 15 Case 5 The lesion of the right ilium has healed well five months after curettage. It measured  $2 \times 1.5$  cm on Oct 22, 1945.

and femurs in 16.6 per cent each. Ten patients had multiple lesions, with an average number of seven bones involved; in one case, reported by Farber, there were 25 lesions. In the group with multiple lesions, the ribs were involved in 33 per cent, vertebrae in 12.5 per cent, and the skull in 11 per cent.

A majority of the patients had mild to severe pain, swelling of the soft tissues, and tenderness over the site of the lesions, with a duration of a few days to several months. Some of the lesions were incidental findings at autopsy or on roentgenograms made for other purposes. A few patients had mild

# The Osseous Manifestations of Eosinophilic Granuloma: Report of Nine Cases<sup>1</sup>

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THE EXISTENCE of a lesion in bone which histologically appears granulomatous, non-specific, and is infiltrated with histiocytes and eosinophilic leukocytes was first reported, simultaneously, in 1940, by Otani and Ehrlich (13) and by Lichtenstein and Jaffe (10). Undoubtedly the lesion had been seen previously, but its exact nature and course were not described.

"Solitary granuloma of bone" was proposed by Otani and Ehrlich (13). Green and Farber (5) suggested "'destructive granuloma of bone,' 'single' or 'multiple' as the case may be, adding parenthetically 'Hand - Schuller - Christian syndrome'." Eosinophilic granuloma, as used by Jaffe and Lichtenstein (8), seems preferable and will be used in this paper.

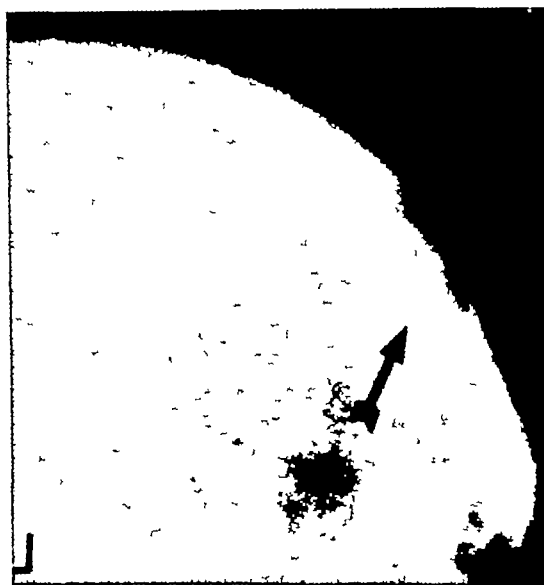


Fig 1 Case I Solitary involvement of left frontal bone. The lesion is oval and appears to have originated in the diploe, with extension through both the inner and outer tables.

Since 1940, a number of authors have reported single examples or small groups of cases, leading to considerable discussion of the relationship of this lesion to the older entities of Hand-Schuller-Christian's disease, or lipogranulomatosis, and Letterer-Siwe's disease, also called reticulosis or non-lipoid histiocytosis (Jaffe and Lichtenstein, 8, Green and Farber, 5, Mallory, 11). Disagreement concerning the exact terminology is, therefore, to be expected.

It is our purpose to present the roentgen findings in 9 cases, confirmed by biopsy, which were seen in an Army General Hospital, together with the pertinent clinical and laboratory findings. In each case the biopsy sections were reviewed and the histopathologic diagnosis confirmed by the Army Medical Museum.

CASE I (Fig 1) White male, 21 years of age. Onset September 1943 with constant headaches and pain in the orbits. There were no convulsions,

<sup>1</sup> Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

in the literature in that mild symptoms of lassitude persist twenty-eight months after the onset. A mediastinal mass also persists in this patient, although high-voltage radiation has been administered in doses which have relieved the symptoms and promoted healing of the bone lesions in other cases.

NOTE: Appreciation is extended to Dr Maxwell Harbin and Dr Frank Gibson for permission to include their cases in this report.

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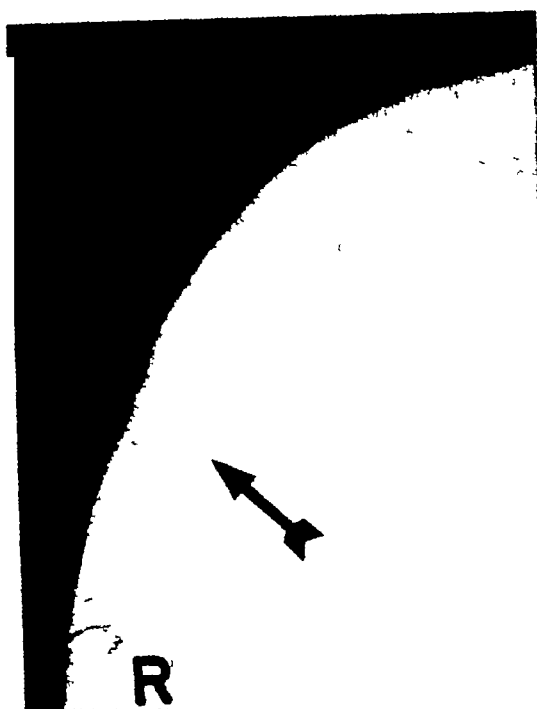


Fig 4 Case IV Right parietal bone Involvement of the outer table is more marked Although a small soft-tissue mass is frequently found at the site of these lesions, there was in this case a palpable defect

**Laboratory Findings** The Kahn test was negative. Nothing unusual was found on urinalysis. The red blood count was 5,400,000, hemoglobin 107 per cent, white blood counts 9,000 to 13,200 (63-71 per cent polymorphonuclears, 31-30 per cent lymphocytes, 2-2 per cent monocytes, 3-6 per cent eosinophils, 1 per cent basophils), blood non-protein nitrogen 26 gm per 100 c c, blood sugar 73 mg per 100 c c, blood cholesterol 154 mg per 100 c c, serum phosphorus 3.5 mg per 100 c c, alkaline phosphatase 4.9 Bodansky units.

At operation the surgeon found sequestered bone fragments with an old organized clot. Following curettage, the pathologist reported that the lesion was eosinophilic granuloma of the bone.

**CASE IV (Fig 4)** White male, age 19 years. Onset three weeks before admission, with frontal headaches associated with diplopia and dizziness. There was a spot over the vertex which was tender to pressure, and palpation revealed a probable bone defect at this point. Except for the lesion in the right parietal bone, a roentgenographic survey failed to reveal any bone involvement.

**Laboratory Findings** The Kahn test was negative. Urinalysis was normal. The white blood count ranged from 5,800 to 9,800. Differential cell counts were repeatedly within normal limits except that on one occasion there were 7 per cent eosinophils. Hemoglobin determinations were normal,

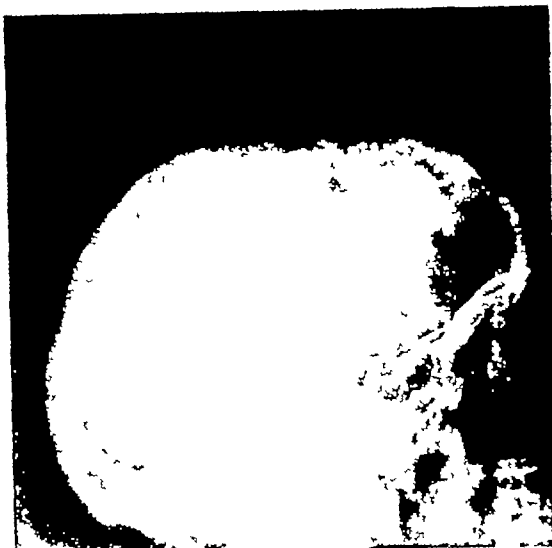


Fig 5 Case V Skull There is extensive involvement of the frontal bone and the anterior superior portions of both parietal bones. The appearance suggests that there has been a coalescence of several smaller lesions. Syphilitic osteomyelitis is simulated, but involvement appears to be greater in the outer table, and the lesion extends across the suture line.

blood cholesterol 132-167 mg per 100 c c, blood calcium 11 mg per 100 c c, phosphatase 4.2 Bodansky units.

Biopsy showed eosinophilic granuloma.

**CASE V (Figs 5 and 6)** White male, age 26 years. The chief complaint was of a mass in the right frontal area of the scalp which had gradually increased in size, with occasional periods of slight recession. There were constant pain and tenderness in the affected area.

**Laboratory Findings** The Kahn test was negative. Nothing abnormal was found on urinalysis,

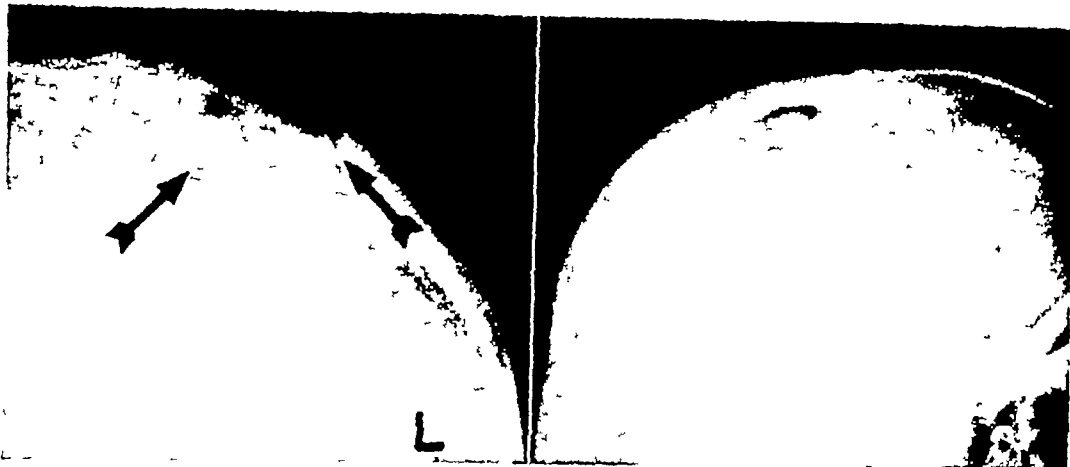


Fig 2 Case II Left parietal bone The lesion is well circumscribed, but the edges are slightly irregular

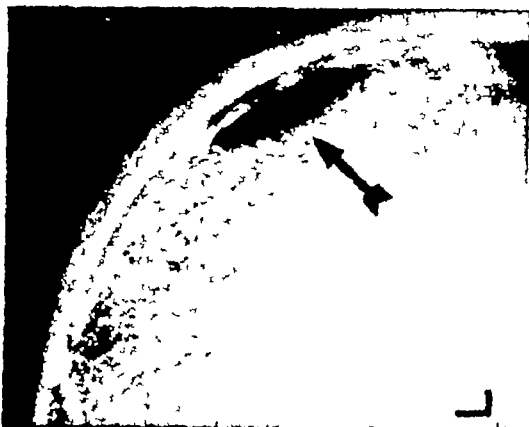


Fig 3 Case III Left parietal bone The lesion is oval and well circumscribed. At operation several small avascular fragments of bone were found, but these could not be seen on the roentgenogram

vomiting, or visual changes. In October, a fluctuant, tender, but non-pulsating mass developed in the left forehead. A roentgenologic bone survey revealed a solitary lesion in the left frontal bone, no similar lesions were present in other bones.

**Laboratory Findings** The Kahn test was negative. Nothing unusual was found on urinalysis, which was negative for Bence-Jones protein. The white blood count was 5,700 (66 per cent polymorphonuclears, 5 per cent eosinophils), blood serum calcium 10 mg per 100 c.c., phosphorus 3.5 mg per 100 c.c., total protein 6.1 gm. per 100 c.c., basal metabolic rate +7, blood cholesterol 194 mg per 100 c.c.

Although at biopsy in November the tumor appeared grossly malignant, involving both tables of the skull, the histologic picture was the classical one of eosinophilic granuloma.

**CASE II (Fig 2)** White male, 24 years of age. Onset October 1943 with trembling and numbness

of right hand. The patient had two episodes of unconsciousness but no headaches. A small mass was palpable in the left parietal region. Physical examination showed the right arm to be weaker than the left. Except for the left parietal lesion, a roentgenographic bone survey was negative.

**Laboratory Findings** The Kahn test was negative. White blood counts of 5,600 to 8,000 were obtained, with 50 to 60 per cent polymorphonuclears, and 3 to 5 per cent eosinophils. The sedimentation rate was normal, total serum protein 7.1 gm per 100 c.c., albumin-globulin ratio 1.3 to 1, blood cholesterol 133 mg per 100 c.c., serum calcium 11.0 mg per 100 c.c., phosphorus 4.0 mg per 100 c.c., alkaline phosphatase 4.9 Bodansky units.

At operation a mass of soft friable tissue measuring about 3 × 4 cm. was removed. This involved both tables of the skull and had invaded the dura and cortex.

Histologically the lesion was an eosinophilic granuloma.

**CASE III (Fig 3)** White male, 27 years of age. One month following an accident in which the patient was struck on the top of his head by the turret of a tank and knocked unconscious momentarily (with persistent headache for four days thereafter), a small mass, soft and semi-fluctuant, developed in the occipitoparietal region. The patient was admitted to this Army General Hospital about four and one-half months after the accident. In addition to the headaches, symptoms had included blurring of vision, mainly in the left eye, episodes of dizziness, and occasional tinnitus in the left ear. On roentgenographic examination, a lesion was seen in the left occipitoparietal region. A bone survey failed to reveal other lesions.

Physical examination revealed a soft, semi-fluctuant tumor about 3 cm. in diameter in the scalp in the left occipitoparietal area. The pupils reacted poorly to light, but the eyes were otherwise normal.



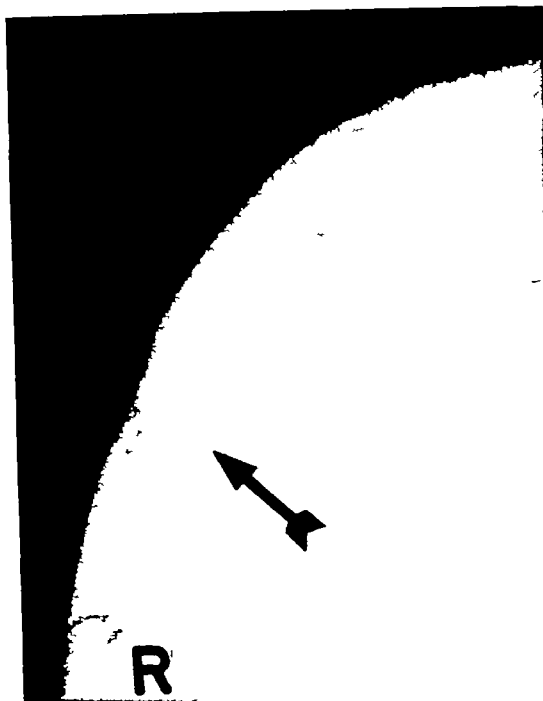


Fig 4 Case IV Right parietal bone Involvement of the outer table is more marked Although a small soft-tissue mass is frequently found at the site of these lesions, there was in this case a palpable defect.

*Laboratory Findings* The Kahn test was negative. Nothing unusual was found on urinalysis. The red blood count was 5,400,000, hemoglobin 107 per cent, white blood counts 9,000 to 13,200 (63-71 per cent polymorphonuclears, 31-30 per cent lymphocytes, 2-2 per cent monocytes, 3-6 per cent eosinophils, 1 per cent basophils), blood non-protein nitrogen 26 gm per 100 c c, blood sugar 73 mg per 100 c c, blood cholesterol 154 mg per 100 c c, serum phosphorus 3.5 mg per 100 c c, alkaline phosphatase 4.9 Bodansky units.

At operation the surgeon found sequestered bone fragments with an old organized clot. Following curettage, the pathologist reported that the lesion was eosinophilic granuloma of the bone.

**CASE IV (Fig 4)** White male, age 19 years. Onset three weeks before admission, with frontal headaches associated with diplopia and dizziness. There was a spot over the vertex which was tender to pressure, and palpation revealed a probable bone defect at this point. Except for the lesion in the right parietal bone, a roentgenographic survey failed to reveal any bone involvement.

*Laboratory Findings* The Kahn test was negative. Urinalysis was normal. The white blood count ranged from 5,800 to 9,800. Differential cell counts were repeatedly within normal limits except that on one occasion there were 7 per cent eosinophils. Hemoglobin determinations were normal,

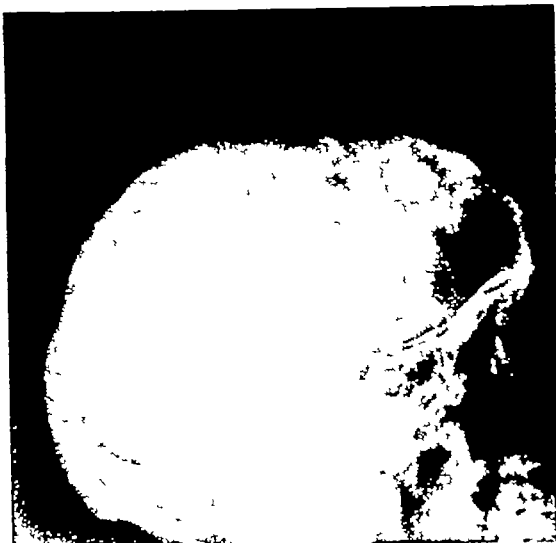


Fig 5 Case V Skull There is extensive involvement of the frontal bone and the anterior superior portions of both parietal bones. The appearance suggests that there has been a coalescence of several smaller lesions. Syphilitic osteomyelitis is simulated, but involvement appears to be greater in the outer table, and the lesion extends across the suture line.

blood cholesterol 132-167 mg per 100 c c, blood calcium 11 mg per 100 c c, phosphatase 4.2 Bodansky units.

Biopsy showed eosinophilic granuloma.

**CASE V (Figs 5 and 6)** White male, age 26 years. The chief complaint was of a mass in the right frontal area of the scalp which had gradually increased in size, with occasional periods of slight recession. There were constant pain and tenderness in the affected area.

*Laboratory Findings* The Kahn test was negative. Nothing abnormal was found on urinalysis,



Fig 6 Case V Left femur This intertrochanteric lesion was asymptomatic and was brought to light only on a skeletal survey. It is confined to the medullary portion of the shaft and is surrounded by a thin zone of sclerosis. A similar lesion was found in the right humerus.

which was negative for Bence-Jones protein. The sedimentation rate was 16 mm/hr, serum calcium 10.7 mg per 100 cc, phosphorus 3.8 mg per 100 cc, alkaline phosphatase 5.1 Bodansky units, acid phosphatase 2.9 Bodansky units, blood protein 6.7 gm per 100 cc, albumin-globulin ratio 4.7 to 2. The complete blood count was within normal limits.

Roentgenologically, there is seen to be a large irregularly shaped defect involving almost the entire frontal bone and the anterior superior portions of both parietal bones (Fig 5). The defect appears to be due to the coalescence of several smaller lesions. Both tables of the skull are involved, and the suture line is crossed. The possibility of syphilitic osteomyelitis was considered in this patient. An oval osteolytic lesion was also found in the intertrochanteric region of the left femur (Fig 6). There was also a small oval osteolytic lesion, 1.5 cm. in diameter, in the proximal end of the shaft of the right humerus. The lesions in the femur and humerus were asymptomatic.

Biopsy showed eosinophilic granuloma.

CASE VI (Figs 7 and 8) White male, age 32 years. In January 1944, the patient first began having pain in the region of the right hip, aggravated by walking. He was then transferred to a hospital, where the only positive finding was a cyst-like lesion in the mandible, which was without symptoms. This was removed by the dentist. Un-

fortunately, a report of the pathologic study of this tissue is not available. Following hospitalization and symptomatic treatment for arthritis, the patient was placed on limited service.

In June 1944, the patient began to suffer from pains in the occipital region of the skull and in the right shoulder. In August 1944, a biopsy showed the lesion in the shoulder to be an eosinophilic granuloma. A course of roentgen therapy relieved the symptoms but, following a convalescent furlough, similar pain developed in the left shoulder. The patient was then referred to this General Hospital for further deep roentgen therapy. Except for the roentgenographic findings, clinical studies revealed nothing of significance.

**Laboratory Findings** The Kahn test was negative. The red blood count was 5,250,000, white blood count 9,600, with 69 per cent segmented cells and 23 per cent lymphocytes, total blood serum protein 8 gm per 100 cc, albumin-globulin ratio 5.2 to 2.9, blood calcium 11 mg per 100 cc.

Roentgenograms revealed an irregular defect in the left occipital bone (Fig 7). There was an area of destruction in the mid-portion of the right scapula. The left scapula appeared normal. The pelvis showed several rounded areas of diminished density in the right ischium (Fig 8). A review of the films from the previous hospital showed regression of the lesions in the right scapula and pelvis. No change was noted, however, in the granuloma in the occipital bone, and following additional therapy roentgenograms failed to show any appreciable change.

CASE VII (Figs 9 and 10) White male, age 19 years. In September 1944, the patient experienced a severe attack of pain in the right thigh, which lasted for fifteen or twenty minutes. The pain recurred a few days later but was only transient. He had no further trouble during the next few months except that, on alighting from a bus or making a similar movement, there would again be sharp pain in the right thigh. In February 1945, while riding on a bus, he experienced an aching pain on the right, involving the whole area from hip to knee, which persisted until his admission to this Army General Hospital in June 1945. The pain was made worse by weight-bearing and, although greatly alleviated by rest, was severe at night, interfering with his sleep. Later, motion of the right hip became restricted. In February and March 1945, there was a loss of 30 pounds in weight associated with anorexia. The history was otherwise non-contributory.

Roentgenograms revealed a soft tissue mass in the left perihilar region and an osteolytic lesion in the right femur. The patient was transferred to this Army General Hospital for deep roentgen therapy.

**Laboratory Findings** The Kahn test was negative, and there were no abnormal findings on urinalysis. The red blood count was 4,450,000, hemoglobin



Fig 7 Case VI Skull The lesion involves the left occipital and parietal bones. It is irregular, but the edges are rounded, suggesting a coalescence of several smaller lesions. There is a so-called "geographic" appearance.

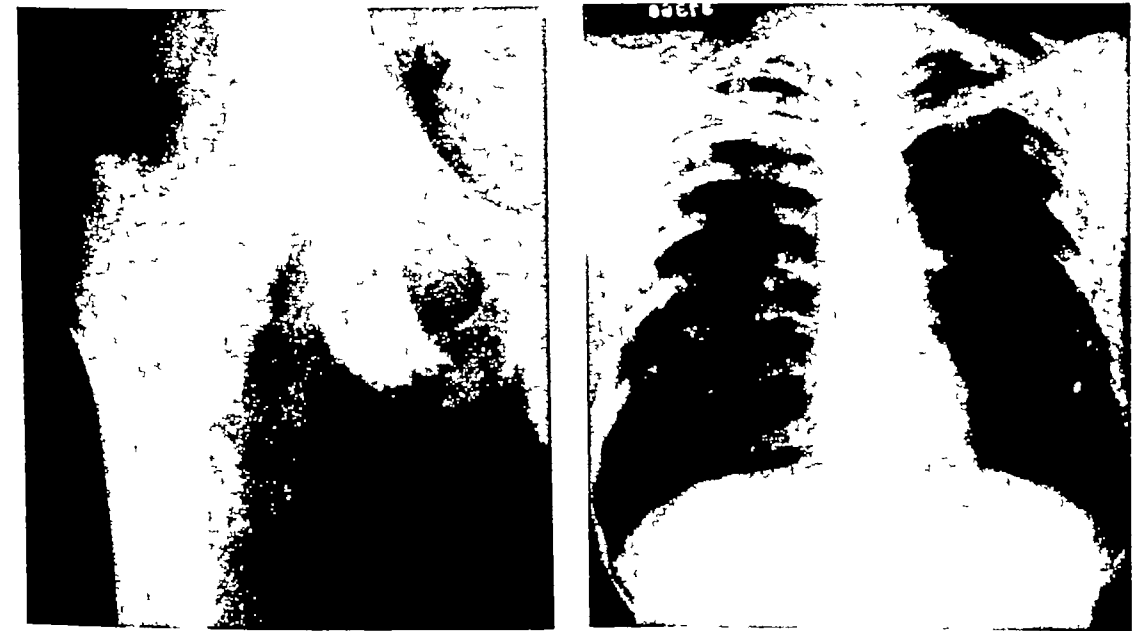


Fig 8 Case VI Right hip, showing a group of small, oval osteolytic lesions in the ischium. Following roentgen therapy, these areas partially filled in with new bone. Roentgen evidence of bone regeneration following irradiation was not our usual experience.

Fig 9 Case VII Chest. A small but definite soft-tissue tumor is seen in the left perihilar region. It is believed to be a lymph node. It underwent partial regression during the period of observation in the hospital. The exact nature of this mass was not determined.

85 per cent, white blood count 12,800, with 76 per cent polymorphonuclears, 19 per cent lymphocytes, 5 per cent eosinophils, sedimentation rate 38 mm/hr (corrected), basal metabolic rate -26, blood serum protein 6.5 gm per 100 cc, albumin-globulin ratio 3.9 to 2.6, blood serum calcium 11.1 mg per 100 cc, phosphorus 3.0 mg per 100 cc,

phosphatase 7.0 Bodansky units. Additional complete blood counts revealed eosinophils in the following percentages, 0, 6, 5, 5, the white blood counts remained slightly increased. The heterophile agglutination was 1-28. The Lederle tuberculin patch test was 2 plus at the 96-hour reading.

Biopsy revealed an eosinophilic granuloma of the



Fig 10 Case VII Right femur, showing osteolytic involvement of the subcapitate region. This gave rise to severe pain. Roentgen therapy relieved the pain, but the lesion nevertheless increased in size, as shown in the view on the right.

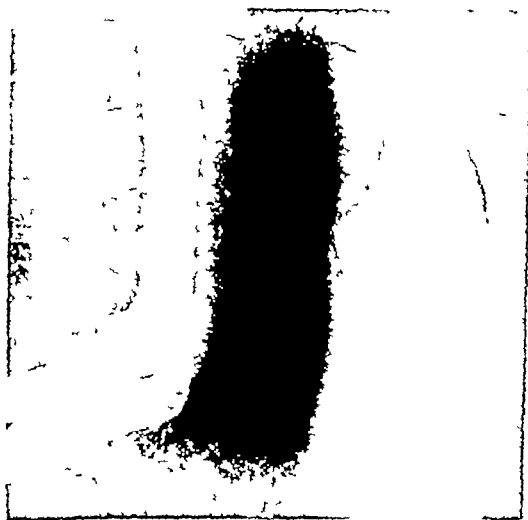


Fig 11 Case VIII Right humerus. The oval, osteolytic lesion in the intercondylar area apparently originated in the medullary portion of the bone with erosion of the cortex on the anterior aspect. There is also a small amount of subperiosteal new bone formation in this area.

femur. Roentgenograms showed that the tumor in the left perihilar region, believed to be an enlarged lymph node, had decreased considerably in size since March.

Following deep roentgen ray irradiation, for a dose of 1,800 r, the patient was entirely relieved of pain and desired to be up and about. A roent-

genogram of the hip, however, taken shortly after the termination of therapy, showed an increase in size of the osseous lesion.

Subsequent to this, a small lymph node was palpated in the left supraclavicular region. In an effort to discover the nature of the process in the lung, this node was biopsied, but microscopic examination showed only fibrosis of undetermined etiology.

**CASE VIII (Fig 11)** White male, age 25 years. In January 1945, the patient experienced intermittent pains in his right shoulder, associated with motion. These became more severe and gradually extended down the arm. Three weeks after onset, a swelling of the right elbow was first noticed. Following unsuccessful symptomatic treatment, a roentgenogram was taken which showed a punched-out area in the distal end of the shaft of the right humerus, and the patient was sent to an Army General Hospital for treatment. Except for the lesion in the humerus, a bone survey failed to reveal any evidence of disease.

**Laboratory Findings.** The Kahn test was negative. The red blood count was 5,300,000, hemoglobin 100 per cent, white blood count 7,500, with 62 per cent neutrophils, 32 per cent lymphocytes, 6 per cent eosinophils, sedimentation rate 3 mm/hr. Other laboratory studies were non-contributory.

The lesion was curetted, and the biopsy report was *eosinophilic granuloma*.

**CASE IX (Figs 12 and 13)** White male, age 21 years. In April 1944, the patient had two lower incisors extracted because they were loose in their sockets. Following this, the sockets never seemed



Fig 12 Case IX Mandible Multiple cystic lesions present in the mandible on both sides caused this patient to seek medical attention for an initial complaint of looseness of the teeth

to heal, and the patient was aware that other lower teeth were loose. For several months this was thought to be due to pyorrhea. In December 1944, at a routine dental check-up, a cyst of the mandible was found, following which the rest of the lower teeth were removed, and a biopsy was taken. Early in February 1945, the patient complained of pain in both thighs. The pain was intermittent and present only during inclement weather. The patient was admitted to an Army General Hospital on May 14, 1945.

Roentgenologically there were numerous osteolytic lesions involving the skull. These had smooth edges and were surrounded by a fine zone of sclerotic bone. Similar lesions were present in the right clavicle and the mid-third of the shaft of each radius. There was severe involvement of the lower halves of both femora roentgenologically simulating fibrous dysplasia or osteitis fibrosa cystica. There were, in addition, numerous destructive cyst-like lesions of the mandible.

While roentgen therapy was being administered to the lesions mentioned above, numerous small osteolytic lesions appeared in the proximal halves of the shafts of the tibiae. Pain in the thighs was relieved during a course of roentgen therapy, although no roentgenologically demonstrable regression of any of the lesions was observed.

**Laboratory Findings** The Kahn test was negative. Red blood counts were 4,030,000–4,500,000, hemoglobin 79 per cent. Differential counts showed 69–66 per cent neutrophils, 27–32 per cent lymphocytes, 2–1 per cent monocytes, 1–1 per cent eosinophils, 1 per cent basophils. Blood serum calcium was 9.6 mg per 100 cc, phosphorus 3.8 mg per 100 cc, alkaline phosphatase 7.9 Bodan-

sky units, sedimentation rate slightly increased, blood uric acid 2.6 mg per 100 cc, blood cholesterol 170 mg per 100 cc. Smears obtained from the sternal marrow showed a normal picture.

Biopsy from the mandibular cyst and the right clavicle revealed eosinophilic granuloma.

#### DISCUSSION

Due probably to the fact that most of our patients are drawn from military personnel, all 9 are young, white, adult males, ranging in age from nineteen to thirty-two years. This is of interest in that the group is older than many series previously reported. One case, reported by Green and Farber (5), was that of a child of two years. Otani and Ehrlich (13) found the condition in a patient of 35 years, and Versiani and his associates (17) had a patient 50 years of age. These, we believe, represent the extreme age range reported to date. In 24 cases which we have found in the literature, in addition to the 9 here reported, the majority of the lesions were seen in the first three decades of life.

Nine of the 10 cases reported by Green and Farber (5) were in males, of the remaining cases in which the sex was given, 11 were in males and 4 in females. In our series all the patients were males. This predominance of males seems to be of

questionable significance since only a small number of cases have been reported, and the present series at least was gathered in a fixed Army General Hospital

No definite racial or geographical distribution could be discovered, either on reviewing the cases in the literature or from our own group. Nor was any familial tendency observed.

*Clinical Findings* The symptoms associated with eosinophilic granuloma usually depend upon the location and extent of involvement of the affected bones. Green and Farber (5) noted in their series that pain was usually the presenting symptom when bones other than the skull were involved. Seven of our 9 patients (Cases I, IV, V, VI, VII, VIII, and IX) suffered from pain localized in or about the site of a bone lesion. In most patients, the pain was from slightly to moderately severe, in 2 (Cases VI and VII) it was very severe. Severe pain was also the complaint in a case reported by Kernwein and Queen (9). The pain is usually aggravated by motion, weight-bearing, or palpation.

Since in most instances the pain is not of great severity, several weeks or even months may elapse before the patient is seen by a physician. One case has been reported in which pain was present for two years (2) before discovery of the lesion. In Cases V and IX, there were silent osseous lesions which were discovered only on a skeletal survey, indicating that the disease may exist for some time before symptoms develop.

When the lesion is localized in a flat bone, as the skull or ribs, the presenting symptom is likely to be a tender swelling, as in some of the reported cases (1, 3, 4, 6) and in our own Cases I, II, and III. One exception was noted in Case IV of our series, in which a tender palpable defect was found over the vertex of the skull. Even when the skull is extensively involved, the neurological signs are likely to be minimal. Headache has been a frequent complaint in our own and in reported cases, but the term "headache" is subject to wide interpretation, it may be due to

pain at the site of the lesion in the skull. In Case II, in which the lesion was located over the left parietal cortex, there were tremor and numbness of the right hand and there had been two episodes of unconsciousness. In Case IV, diplopia and dizziness were present, secondary to a lesion in the right parietal bone. Two cases of skull involvement have been reported in which there was a Bell's palsy in one, reported by Osborne, Freis, and Levin (12), there was roentgen evidence of temporal bone involvement, in the other, one of the "Cabot cases" (3), an involvement of this bone was not demonstrated, although the presence of a small lesion strategically located was suggested by Dr Green in discussing the case.

A rare initial symptom, present in our Case IX, is looseness of the lower teeth, subsequent roentgen-ray examination disclosed the destructive process in the mandible. In a case with primary involvement of the mandible reported by Thoma (16), a painful swelling of the jaw was found with malposition of the teeth, but no mention was made of their being loose. Another patient (Case VI) had a cyst in the mandible, but this was asymptomatic and no pathologic study was available.

Although in some of our patients lesions in the long bones were present, and these men had been exposed to the rigors of military life, in no instance was a pathological fracture found. In only one case has a fracture been reported in the literature, and this was found at biopsy (Otani and Ehrlich, 13).

In none of our cases was there any noteworthy change in pulse or respiration, nor was intermittent or sustained elevation of temperature found. Only one of our patients (Case VII) reported a weight loss, 30 pounds within two months. A similar finding was reported by Kernwein and Queen (9), one of their patients having lost 25 pounds in weight.

No proved visceral manifestations of eosinophilic granuloma seem to have been found. If, as has been suggested, this disease is related to Hand-Schüller-Chris-

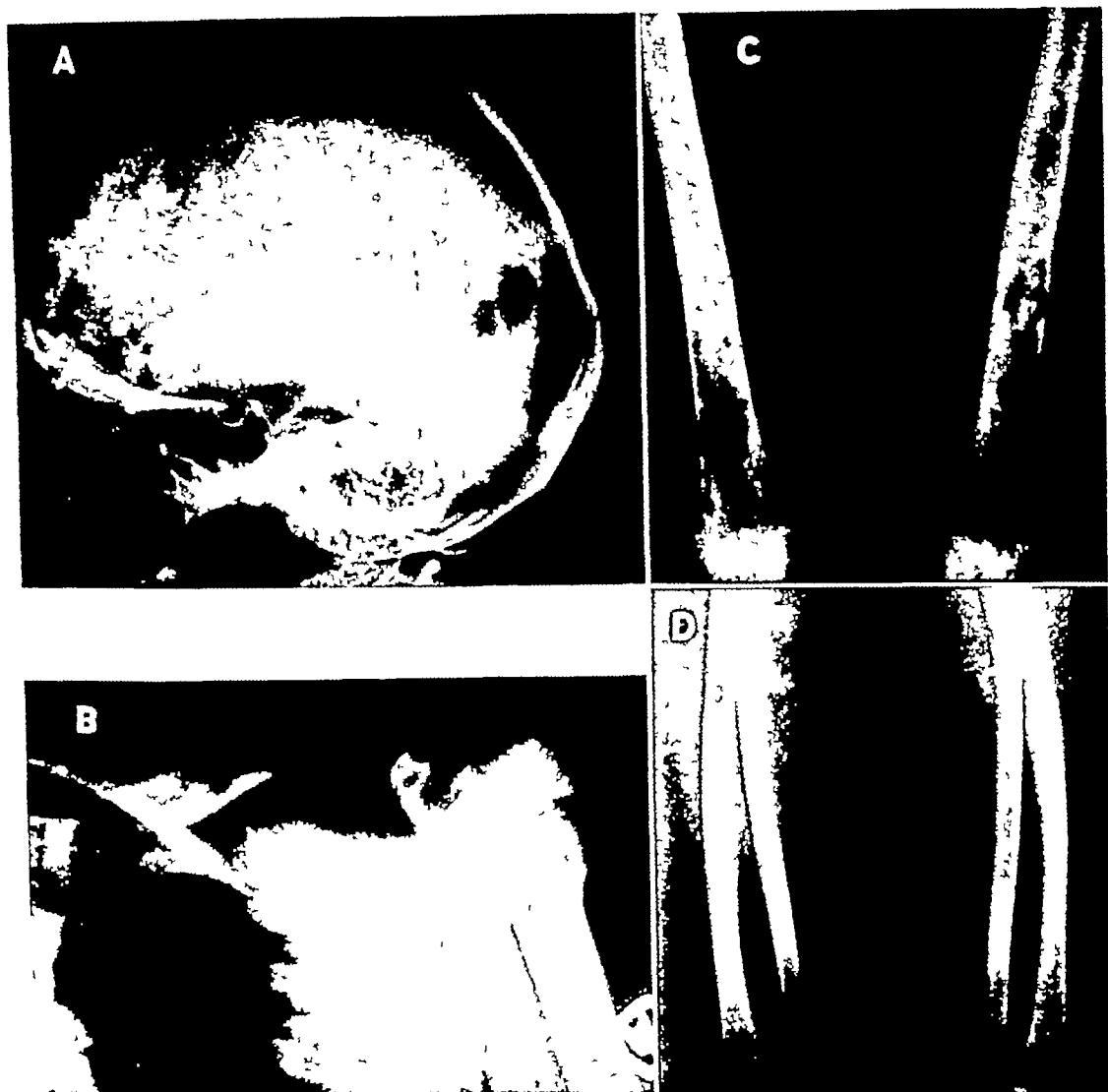


Fig 13 Case IX A The skull B Right clavicle C Both femora D Both radii A multiplicity of lesions was present in this patient Very few of the lesions were symptomatic, most of them being brought to light only on a skeletal survey The alkaline phosphatase level was 7.9 Bodansky units

tian's disease (Green and Farber, 5, Jaffe and Lichtenstem, 8, and Mallory, 11), other organs, particularly those of the reticulo-endothelial system, might be expected to show lesions of the same type. In our series, we were unable to find any evidence of enlargement of the liver, spleen, or lymph nodes, except in one patient (Case VII) in whom an enlarged lymph node was found in the left perihilar region, and a palpable node was found in the left supraclavicular area. Biopsy of the node from the supraclavicular region,

however, showed only a fibrotic process. The lymph node present in the left hilum (Fig. 9) regressed while the patient was under hospital observation. No statement as to its exact nature can be made.

Two cases of eosinophilic granuloma associated with diabetes insipidus have been reported by Versiani *et al* (17) and by Thoma (16). This is an interesting observation, since diabetes insipidus is described as part of the Schuller-Christian triad. There was no definite roentgen evidence of involvement of the base of the skull in

either case and, since there were no pathological studies of the tissues in and about the pituitary, the cause was not established microscopically

*Laboratory Studies* No marked deviation from the normal in the blood count was found in any of our patients. A slight leukocytosis was present in only 2 (Cases VII and IX) but has been reported by others (Jaffe and Lichtenstein, 8, Green and Farber, 5). A number of authors have found an increase in the percentage of eosinophils in the peripheral blood (Lichtenstein and Jaffe, 10, Bass, 1, Horwitz, 7). The percentage of eosinophils in the differential cell counts of our patients is given in the case reports. In 6 of the cases, at one time or another, the eosinophil count exceeded 4 per cent, the highest count was 7 per cent. A slight increase in the percentage of eosinophils, therefore, while not a constant finding, may suggest that a bone lesion is an eosinophilic granuloma. A sternal marrow puncture performed in Case IX produced a normal smear.

No deviations from the normal were found in blood serum calcium and phosphorus studies. The proteins of blood plasma and the albumin-globulin ratio were consistently within normal limits. In only 2 of the cases was the alkaline phosphatase increased: in Case VII, 7 Bodansky units, and in Case IX, 7.9 Bodansky units were reported. The former patient had a solitary osteolytic lesion, the latter, multiple osteolytic lesions. Blood cholesterol ranged from 132 to 194 mg per 100 c.c., and in only one case exceeded 170 mg. A serologic test for syphilis was negative in all cases. The sedimentation rate was elevated in 3 cases, in 2 of which the deviation from normal was slight. Other serologic and chemical determinations were within normal limits. Several authors (Jaffe and Lichtenstein, 8, Otani and Ehrlich, 13, Green and Farber, 5) have made smears and cultures of the lesions, but no pathogenic organisms have been discovered.

*Roentgenographic Appearance* The os-

seous lesions reported in this study have all been osteolytic and tend to be rounded (Figs 1, 2, 3). The shape, however, may be variable, suggesting the coalescence of several smaller lesions, and in the cranial vault giving rise to a "geographic" appearance (Figs 5 and 7). The lesions are usually sharply defined (Fig 2). A very thin zone of sclerosis may surround the osteolytic area but usually does not. Aside from this, there is very little evidence of reactive new bone formation. In the skull, the lesion has little respect for the suture lines and usually involves both tables of the calvarium (Fig 5). When involvement of the outer table is greater, there is usually a soft-tissue mass, which is often palpable. In the long bones, the lesion has been seen to erode through the cortex (Fig 11), but this is not a frequent occurrence. Very little subperiosteal new bone formation has been noted. It is felt that these factors attest to the benign and insidious growth of the granulomas.

Practically every bone in the body, with the exception of the carpals, metacarpals, and phalanges, and the corresponding bones of the feet, have been found to harbor eosinophilic granuloma. There seems to be no characteristic localization of the lesion within the bone, the epiphysis, metaphysis, and the diaphysis are all known to have been involved. In Cases I, II, III, IV, and VIII, the lesion is assumed to be solitary, since no additional lesions could be demonstrated by a skeletal survey. The remaining patients showed multiple bone involvement, and in several instances there were multiple lesions in individual bones.

*Differential Diagnosis* On the basis of the roentgen appearance, the diagnosis of eosinophilic granuloma may be strongly suggested, but histopathologic confirmation is necessary. A well circumscribed osteolytic lesion, with little evidence of reactive new bone formation, in a child or young adult, is suggestive of a granuloma. Solitary cyst-like lesions in the cranial vault, about 1 to 1.5 cm in diameter, in young adults are, in our experience, often



eosinophilic granulomas (Figs 1, 2, 3, 4) The condition may, however, be closely simulated by a fibrosing osteitis developing after a closed injury to the skull Meningiomas eroding the cranial vault and epidermoid cysts can usually be differentiated from eosinophilic granulomas on an analysis of the films The meningiomas erode the inner tables more than the outer, and the epidermoid cysts originate in the diploe and expand through both the inner and outer tables of the cranial vault

The various osseous lesions encountered in this series roentgenologically closely simulated a variety of pathological entities The similarity to the osseous lesions of Hand-Schüller-Christian's disease is well illustrated in Figures 7 and 13 The likeness to cystic lesions of bone, including those of the jaw (Fig 12), solitary bone cysts, osteitis fibrosa cystica, and fibrous as well as chondrodysplasia of bone, is apparent in Figures 8 and 13, c and d In one patient, a low-grade osteomyelitis, probably syphilitic, was considered when the skull films (Fig 5) were first examined Figure 10 shows a lesion which radiographically closely simulates a metastatic tumor Figure 11 is suggestive of an osteogenic sarcoma

This is obviously not a complete list of the lesions which may be simulated radiologically Ewing's tumors, myelomas, giant-cell tumors, and other osseous lesions which may be confused have been mentioned by others One of the patients in this series was transferred to this hospital with a tentative diagnosis of multiple myeloma

A roentgenographic bone survey is usually necessary to find multiple lesions, many of which are apt to be asymptomatic

**Treatment** Treatment is either by surgery or roentgen therapy, or a combination of the two, or by watchful waiting Jaffe and Lichtenstein (8) have reported spontaneous healing of an otherwise untreated lesion Operation on at least one lesion found in a patient is obviously necessary for confirmation of the diagnosis Curettage of a small lesion is apparently

TABLE I TREATMENT IN NINE CASES OF EOSINOPHILIC GRANULOMA OF BONE

Case	Treatment	Total Roentgen Irradiation to Any One Site
I	Biopsy	None
II	Surgical and roentgen therapy	2200 r
III	Surgical	None
IV	Biopsy	None
V	Biopsy and roentgen therapy	1500 r × 2
VI	Surgery and roentgen therapy	1200-1200-600 r
VII	Biopsy and roentgen therapy	1800 r
VIII	Surgical	450-1200 r
IX	Biopsy and roentgen therapy	1200 r × 9

Roentgen therapy was administered with the G E Maximar 220-kv machine The factors were 220 kv, 15 ma, 0.5 to 1.0 mm Cu plus 1.0 mm Al filter, HVL 0.9-1.35 Cu, 50 cm t s d Dosages varied from 150 r every other day to three times a week, and 200 r every day to every other day The portals were of adequate size to cover the individual lesions or involved areas

adequate treatment, and uneventful healing usually follows We were unable to determine whether or not roentgen therapy was helpful in combination with curettage.

Following irradiation pain was relieved. In this series, with a relatively short period of follow-up, there was no roentgen evidence that such therapy altered the course of the disease, except possibly in Case VI, in which there was evidence of regression subsequent to treatment This, of course, may have been coincidental In Case IX, while the patient was receiving a course of roentgen therapy, new lesions appeared Since we were unable to follow these patients over a long period of time, it is possible that delayed resolution with reossification may have taken place subsequently in some instances

Cases II, V, VI, VII, and IX of this series received roentgen therapy by several techniques, varying from small and infrequent to large and more frequent doses (see Table I) The results were comparatively uniform Pain was relieved and, when function of an extremity had been limited, it was resumed Such relief continued during the period of our observation Subsequent roentgenographic studies did not show a greater or earlier degree of bone repair in the irradiated areas as compared

with those areas which had received no irradiation. In Case VII, there was an increase in the size of the granuloma, even though treatment had involved biopsy and roentgen irradiation.

In our experience, roentgen therapy is indicated for the relief of pain. It is also possible that small doses of roentgen rays over longer periods might be helpful in obtaining radiographically demonstrable regression of many of these lesions.

#### SUMMARY

1 Nine cases of eosinophilic granuloma of bone, confirmed by histopathological examination at the Army Medical Museum, have been reported, with clinical and laboratory findings.

2 The roentgenographic manifestations and the differential diagnosis have been discussed.

3 In one patient, there was an enlarged perihilar lymph node of undetermined etiology which underwent partial spontaneous regression during the limited period of observation.

4 The necessity for confirmation of the diagnosis by biopsy has been stressed.

5 The use of roentgen therapy has been discussed. In our experience, irradiation relieved the pain associated with the lesions.

**ACKNOWLEDGMENTS** We appreciate the help and co-operation received from many of the members of the surgical and pathological services. We are especially indebted to George S. Baker, M.D., for his permission to include the neurosurgical cases, some of which he has reported orally. We understand that Dr. Baker plans to report the neurosurgical aspects with a follow-up over a longer period of time.

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# Congenital Atresia of the Esophagus and Tracheo-Esophageal Fistula<sup>1</sup>

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THE RELATIVELY meager roentgenologic literature on the subject of congenital esophageal atresia has dealt almost exclusively with isolated case reports. The apparent reason why more comprehensive analyses of the subject have not appeared is that, until very recently, this interesting anomaly has been universally fatal and generally regarded as a distinct medical oddity. The condition is relatively uncommon, but through various improvements in surgical technic and postoperative care it has been brought into the realm of surgically correctable abnormalities, and greater interest is being taken in the establishment of its diagnosis. Many of the diagnostic and therapeutic problems which have arisen confront the roentgenologist directly, because it is largely by his methods that the diagnosis of esophageal atresia, the recognition of its complications, and the results of surgical management are graphically recorded. It may be stated justifiably that roentgen examination is essential in the proper management of the condition, especially during the postoperative period.

The purpose of this report is to review the previously described roentgenologic findings in esophageal atresia and tracheo-esophageal fistula, and to present some additional observations made in the group of 46 patients with various combinations of these anomalies seen at the University Hospital since July 1935.

## LITERATURE

For excellent embryologic descriptions of the anomalies under discussion, the reader is referred to the articles of Singleton and Knight (1) and of Chont and Starry (2). The anatomic relationships

of the usual type of combined esophageal atresia and tracheo-esophageal fistula are shown particularly well in postmortem roentgenograms which illustrate a case reported by Sussman (3). Brennemann's description (4) of the clinical findings in these patients is classical. Comprehensive summaries of the cases reported in the medical literature have been contributed by Plass (5), Rosenthal (6), Strong and Cummins (7), and Ashley (8). Methods of surgical management are contained in the communications of Leven (9, 10), Lanman (11), Ladd (12), Haight and Towsley (13), and others (14-20).

## CLASSIFICATION OF LESIONS

Vogt's widely quoted classification of esophageal anomalies (21) has withstood the test of time because it is simple and usable. He lists the following types:

- |          |   |
|----------|---|
| Type I   | Complete absence of the esophagus   |
| Type II  | Atresia of the esophagus with an upper and lower esophageal segment, each ending in a blind pouch |
| Type III | Atresia of the esophagus with tracheo-esophageal fistula  |
|          | <i>a</i> With fistula between upper segment and trachea   |
|          | <i>b</i> With fistula between lower segment and trachea   |
|          | <i>c</i> With fistula between both segments and the trachea                                       |

To this group might be added that form of single tracheo-esophageal fistula which exists without esophageal atresia. This type is unusual and presents particular diagnostic difficulties.

Type III *b* is the most common combina-

<sup>1</sup> From the Departments of Roentgenology and Surgery, University of Michigan, Ann Arbor, Mich. Read by title at the Thirty first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

tion of anomalies encountered in the esophagus and trachea. Rosenthal (6) reported the presence of this particular abnormality in 215 of 255 collected cases, an incidence of 84 per cent. In the present series of 46 patients, 42 (91.3 per cent) were in this category. Two patients were found to have agenesis of the lower esophageal segment, one had a single fistula between the esophagus and trachea without esophageal atresia, and in one instance the exact type of anomaly was never accurately determined.<sup>3</sup> Because of the overwhelming predominance of Type III *b*, most of the following remarks will be referable to that type of the anomaly.

#### CLINICAL FINDINGS

The signs and symptoms of esophageal atresia are quite uniform and fairly characteristic. Inability to swallow fluids, attacks of choking, dyspnea and cyanosis especially during attempted feeding, and intermittent accumulation of mucus in the pharynx with resultant respiratory obstruction constitute a clinical picture that should not go unrecognized. Inability of the examiner to pass a catheter into the infant's stomach will permit a presumptive diagnosis of at least partial esophageal obstruction, but roentgenologic examination is necessary for a positive diagnosis of complete esophageal atresia.

#### ROENTGENOLOGIC CONSIDERATIONS

Roentgen examination should begin with careful fluoroscopy of the chest in both the anteroposterior and lateral projections without the use of any contrast medium. Following fluoroscopy, roentgenographic exposures are made. These procedures enable the observer to evaluate the status of the lungs more accurately than is possible if opaque material is present in the esophagus or has inadvertently flowed into the tracheobronchial tree. The importance of a careful analysis of the pulmonary

status preoperatively lies in the fact that some degree of pneumonia frequently occurs as a result of aspiration of attempted feedings or of secretion within the pharynx or upper esophagus. Because of the blind proximal esophageal pouch, these fluids collect in the upper esophagus and tend to overflow into the lungs through the larynx, producing atelectasis or pneumonic consolidation. These complications are the most important immediate causes of death in patients with esophageal anomalies.

Pulmonary atelectasis may be either of the fetal type, due to incomplete expansion of a portion of lung following birth, or of the acquired type, incident to the aspiration of pharyngeal secretions and feedings into the bronchial tree. Fetal atelectasis occurs most often in the right upper lobe. In this location, indirect signs denoting loss of pulmonary volume usually are not seen on the roentgenogram, although abnormal mediastinal shift on respiration may be demonstrable fluoroscopically. Obstructive atelectasis likewise is more apt to involve the upper portions of the lungs, particularly on the right side. When atelectasis is present, postural treatment may be followed by spectacular roentgenographic changes within a matter of minutes (Fig 1).

Frequently it is not possible to distinguish atelectasis from pneumonia in these infants, and one has to be content merely to designate that abnormal increase in density is present in one or more lobes. In this series of 46 patients, 45 had anteroposterior roentgenograms of the chest on admission. Abnormal increase in density was observed in the lungs of 27 of the group. The right upper lobe was involved most often, pneumonia, atelectasis, or both, occurring in this region in 22 patients.

Preliminary roentgenologic survey of the chest may reveal occasional associated developmental defects, such as congenital cardiac anomalies. In this group, three such lesions were recognized by x-ray examination (Fig 2).

In general, the incidence of various extra-esophageal congenital defects was

<sup>3</sup> In this indeterminate case, roentgenograms showed definite atresia of the proximal esophagus. Absence of air shadows in the gastro-intestinal tract suggested that no tracheo-esophageal fistula was present, but this was not confirmed, since operation was not undertaken and autopsy was not obtained.

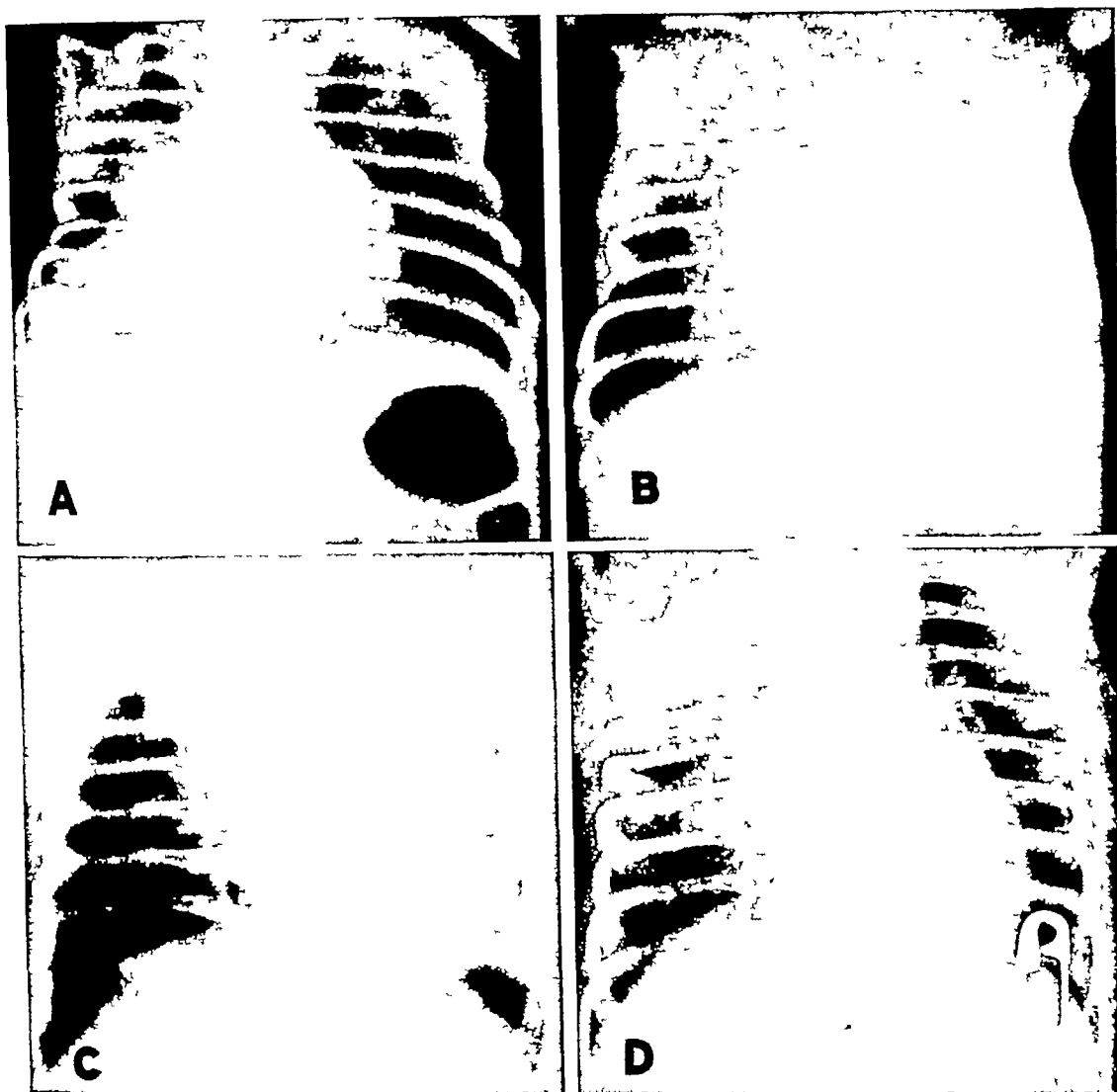


Fig 1 Preoperative bedside films showing rapid effect of postural change on atelectasis. A (Case No 520879) Abnormal density (presumably atelectasis), right lower lobe. Note iodized oil in blind upper esophageal segment. B Same patient twenty-four hours later. The right lower lobe has cleared but the right upper lobe and entire left lung are now involved. C (Case No 522664) Atelectasis of both upper lobes. D Same patient only three hours later, with complete clearing of left lung. Oil in upper esophagus. (C and D reproduced by permission of *Annals of Surgery*, from Haight 18)

relatively low in this series of cases, it did not approach the high rate of occurrence (63 per cent in 149 patients) reported by Plass (5) in his exhaustive review of the literature up to 1919. All but one<sup>3</sup> of the anomalies discovered in our patients, including those found at autopsy, were of a type entirely compatible with life. Ladd (12), on the other hand, encountered a

large number of serious malformations in other portions of the body occurring in conjunction with esophageal anomalies.

*Diagnosis of Esophageal Atresia Without Use of Contrast Media* Various methods have been described by which a diagnosis of atresia of the esophagus and tracheo-esophageal fistula can be made from films alone, without the help of contrast media. Solis-Cohen and Levine (22) state that a lateral projection of the chest may show a

<sup>3</sup> This patient had congenital heart disease with pronounced cyanosis. Operation was not undertaken.

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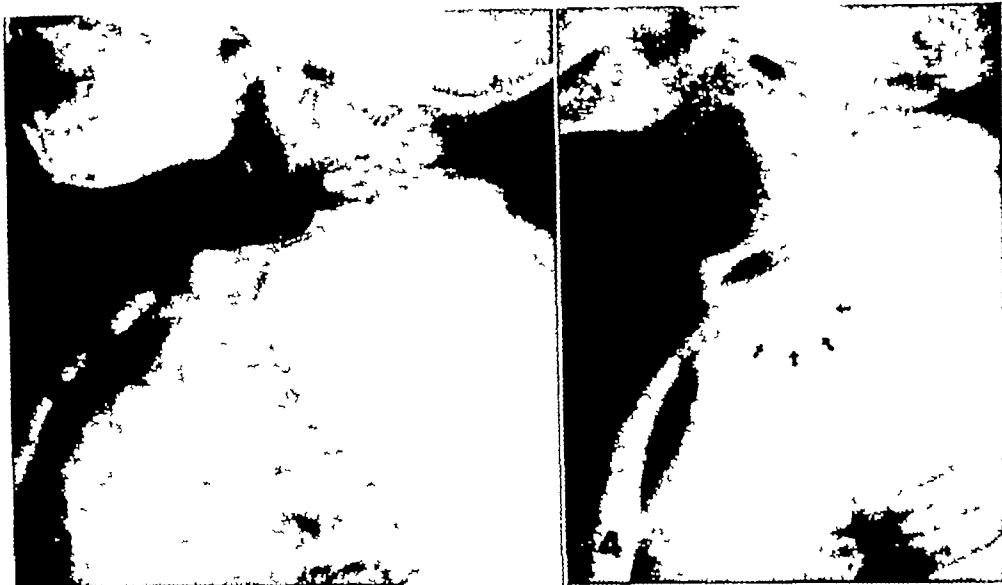


Fig 3 (Case No 571090) Anterior displacement and compression of trachea adjacent to dilated, hypertrophied upper esophageal segment, which contains iodized oil and air

Fig 4 (Case No 557442) Dilated proximal esophageal segment completely outlined by swallowed air. Arrows indicate lower margin of blind pouch

As previously stated, insertion of a small soft rubber catheter (No 10-12F) into the esophagus is of value in establishing the presence of obstruction. If the catheter reaches the stomach, as indicated by aspiration of gastric contents, this procedure will quickly rule out the presence of esophageal atresia. If gastric contents cannot be aspirated after the catheter has been introduced sufficiently far to reach the stomach, fluoroscopy with the catheter in place is essential to determine if obstruction has been met in the upper esophagus. The catheter may loop back upon itself (Fig 5) and, without roentgenologic confirmation in such instances, an erroneous diagnosis of esophageal patency may be made.

Even under fluoroscopic control, the use of a catheter alone has serious shortcomings, the main one being that it will disclose neither the presence of partial esophageal obstruction nor fistula formation between the proximal esophageal segment and the trachea. Failure to recognize the latter anomaly preoperatively might prove unfortunate, particularly if it occurred in association with an identified fistula be-



Fig 5 (Case No 512468) Characteristic looping of soft rubber catheter in upper esophagus, denoting site of atresia as well as dilatation of upper esophageal segment

tween the trachea and the distal esophageal segment. Surgical correction of the distal fistula would not cure the patient because of the persistent proximal tracheo-esophageal communication.

Tucker and Pendergrass (27) have re-

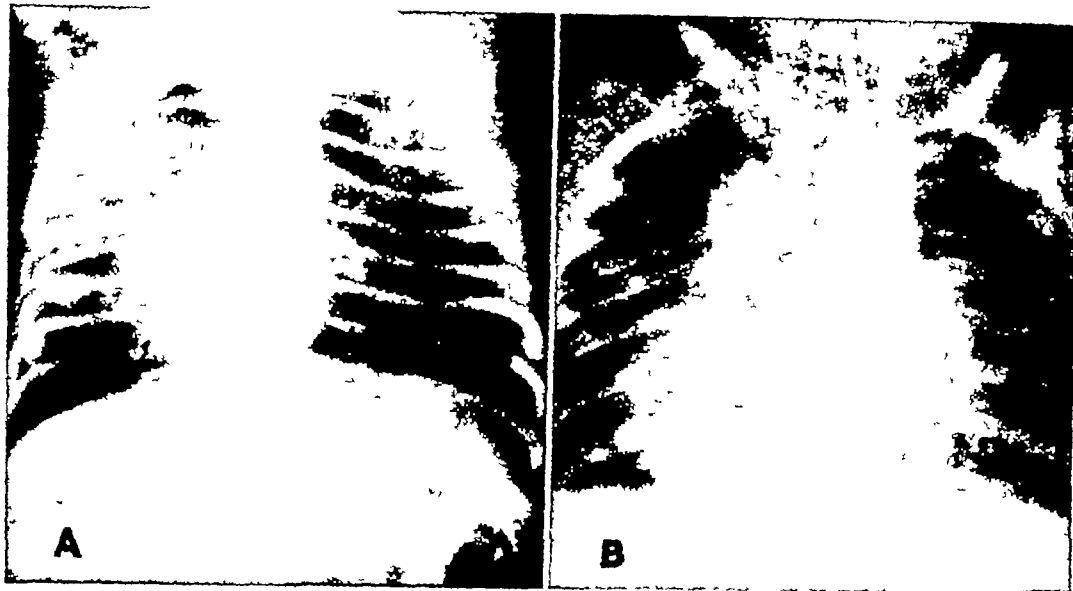


Fig 2 (Case No 528008) Congenital esophageal atresia with associated dextrocardia A Preoperative film at one week B Postoperative film showing reconstructed esophagus six months later Note shape and position of heart and aorta (From Haight, 18 Reproduced by permission of *Annals of Surgery*)

"pencil-like" airway leading from the bifurcation of the trachea to the stomach. Thus, they maintain, represents the lower esophageal segment filled with air. In addition, they feel that the absence of air in the proximal portion of the esophagus indicates retention of secretions in a blind pouch and therefore is of diagnostic significance.

Fuhrman *et al* (23) contend that these diagnostic criteria are unreliable, pointing out that normal bronchovascular markings may simulate the "pencil-like" airway, that the lower esophagus may be clearly delineated in an infant without a tracheo-esophageal fistula as the result of regurgitation of gas from the stomach, and that the presence of air in the proximal esophagus frequently cannot be seen in the normal infant. In a later article, however, these same authors (24) reported a case of their own in which they observed this controversial airway connecting the trachea and stomach.

Selander (25) reports another sign which may be helpful in the diagnosis of esophageal atresia. He believes that the proximal blind esophageal segment, which is

almost always dilated and hypertrophied, will produce a characteristic anterior displacement and narrowing of the trachea demonstrable in the lateral projection.

Of the signs just mentioned, anterior displacement of the trachea with some degree of compression of its posterior margin was the only one found with any degree of regularity in our group of patients. It was seen in 24 (60 per cent) of the 40 patients for whom lateral roentgenograms were made (Fig 3). The occurrence of air in the proximal esophagus is largely fortuitous, and no great significance should be attached either to its presence or absence unless a dilated, blind upper esophageal segment is completely outlined by swallowed or injected air (Fig 4). Under such circumstances, it is conceivable that a fluid level might be demonstrated at the base of the pouch if a lateral film were made with the patient upright. We have attempted to show such a fluid level in the last two patients examined, but we have not succeeded. No instance of a lower esophageal airway was recorded and none could be found in a careful retrospective review of roentgenograms.





Fig 7 (Case No 498016) Effect of respiratory phase on position of atretic upper esophagus  
 A Lateral film showing low position of oil-filled pouch at end of inspiration B Pronounced elevation of esophageal pouch near end of expiration

Following instillation of iodized oil into the blind upper esophagus, the infant should be kept in the prone position as much as possible, as there is less chance of aspiration of the opaque substance than there is if the supine position is employed. When films are exposed, they too should be made with the infant prone.

The iodized oil is removed by suction immediately after the roentgen examination. Inspection of the withdrawn fluid and check-up fluoroscopy are precautions to be taken to assure complete removal of the oil.

Experience has shown that, in addition to the establishment of the presence of esophageal atresia, certain other observations are worthy of note. The position and length of the proximal esophageal pouch are of considerable importance and should therefore be routinely recorded. In this respect, fluoroscopy offers a more accurate means of determining the length

of the proximal segment than does roentgenography alone. Thus, if one attempts to determine operability solely from the position of the upper segment on a single film, his interpretation is apt to be fallacious (13). Roentgenograms in one case in this group showed the distal end of the proximal esophageal pouch extending only as low as the first dorsal vertebra. At operation, this segment was found to be actually longer than the average, extending almost to the tracheal bifurcation and overlapping the distal esophageal segment. This paradox is due to the fact that the proximal segment, instead of being a fixed structure, moves freely but variably with respiration, descending on inspiration and ascending on expiration (Fig 7). The amplitude of this rhythmic excursion is of some prognostic significance in so far as feasibility of surgical anastomosis of the esophageal segments is concerned and, therefore, deserves careful evaluation.

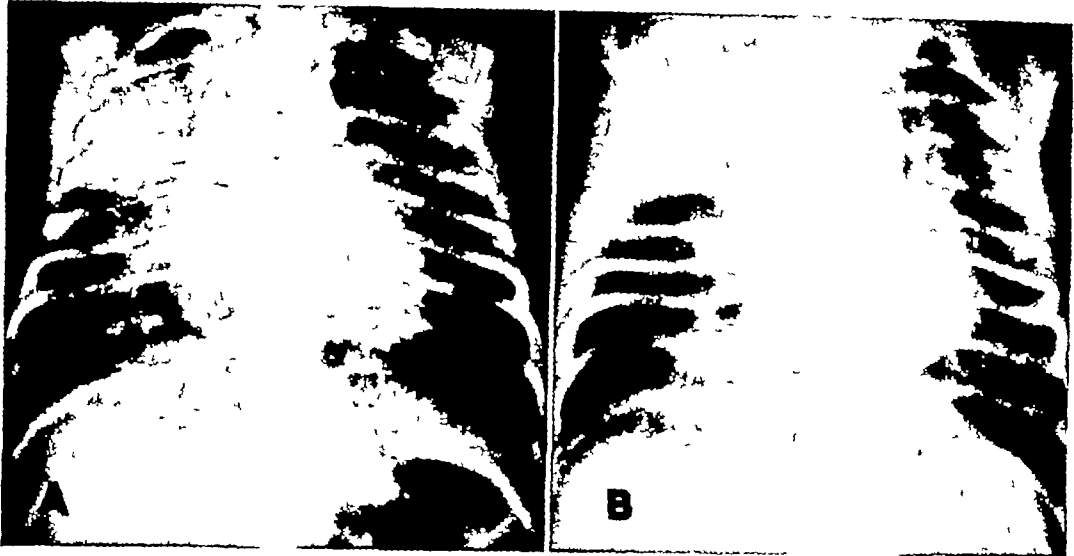


Fig 6 (Case No 502704) A Extensive overflow of iodized oil from upper esophagus into trachea, with resultant aspiration. The opaque medium has entered the lower esophageal segment and stomach via the tracheo-esophageal fistula. B A roentgenogram forty-eight hours later strongly suggests lipid pneumonia.

ported a case of type III *b* anomaly, in which an elaborate and highly accurate modification of the catheter technic was employed for diagnosis. Atresia of the upper esophageal segment was viewed directly through a 3.5-mm esophagoscope and then confirmed by feeding the infant a thin bismuth mixture and obtaining appropriate roentgenograms. Following withdrawal of the bismuth with a catheter, a 3.5-mm bronchoscope was passed into the trachea and the tracheo-esophageal fistula was seen. Finally, a small opaque catheter was passed through the bronchoscope into the fistula. Under fluoroscopic control, the catheter was seen to pass into the lower segment of the esophagus and on into the stomach.

**Contrast Media** The use of barium sulfate in any form to demonstrate esophageal atresia is unanimously condemned because of the unquestioned irritating effects of this non-absorbable substance should it gain entrance into the lungs.

Fuhrman *et al* (23, 24) have advocated the use of air as a contrast medium and report a case in which it was employed to good advantage. Under fluoroscopic guidance, a soft rubber catheter was inserted into the esophagus, after the point of

atresia was encountered, a few cubic centimeters of air were injected into the proximal esophageal pouch by means of a small bulb syringe attached to the catheter. The dilated, blind cul-de-sac was then observed on the fluoroscopic screen and on subsequent roentgenograms.

The judicious use of bland iodized oil under careful roentgenoscopic control is the most satisfactory method of producing graphic roentgenologic proof of the anomaly. It should be emphasized, however, that the use of oil is not without danger, especially if it is given in an unduly large amount, because of the likelihood of its aspiration into the lungs. Clinically, iodized oil is non-irritating in normal lungs, but Weinberg (26) has convincingly demonstrated histopathologic changes attendant upon its use, particularly in abnormal lungs.

It has been found that the minimal amount of 10 c.c. of oil is sufficient for diagnostic purposes, and this small quantity is not likely to overflow into the trachea. Several of the patients in this series were given objectionably large amounts of iodized oil and, in at least one case (Fig 6), it may have contributed to a lipid pneumonia which proved fatal.

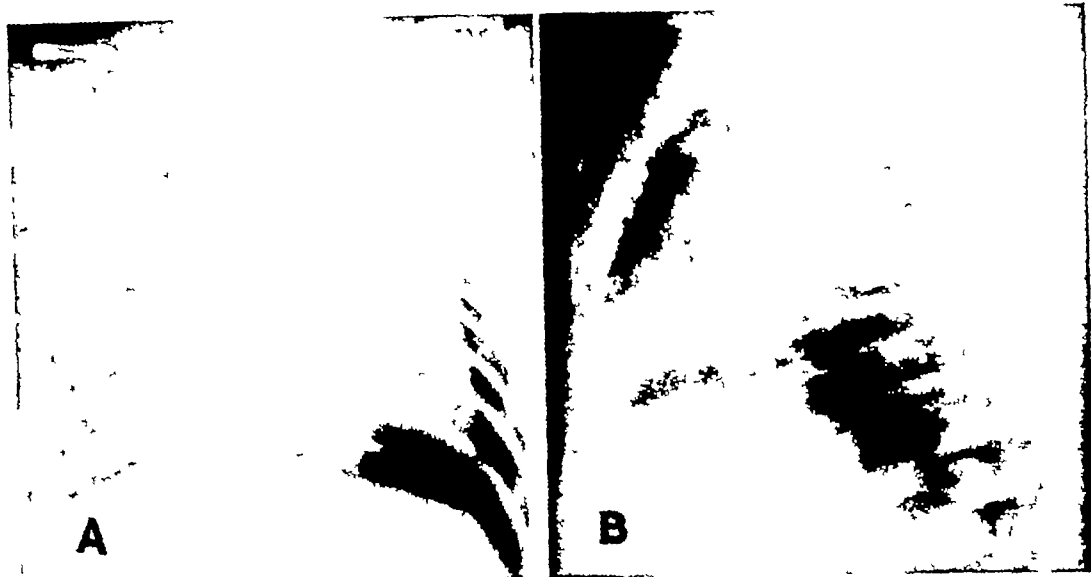


Fig 9 Clinically unsuspected postoperative pulmonary complications observed on bedside roentgenograms in two different patients. A (Case No 519887) Left-sided pneumothorax. B (Case No 563843) Atelectasis of right middle lobe. Both abnormalities responded promptly to proper treatment.

only recently but so far have not observed it.

Should iodized oil inadvertently enter the trachea, it may pass through the tracheo-esophageal fistula and lower esophagus and thereby gain entrance into the stomach (Fig 6, A). If this fact is not kept in mind, the finding of oil in the stomach or small bowel may lead to the wrong assumption that it was swallowed, reaching the gastrointestinal tract through a patent esophagus. Rarely, the lower esophageal segment with its characteristically tapered proximal end will be outlined, but this is undesirable and unnecessary as far as diagnosis is concerned.

Purposeful instillation of opaque medium *via* an intratracheal catheter to outline a fistulous communication between the trachea and esophagus is mentioned only to be condemned. Even with use of the catheter to control the flow of oil, there would seem to be considerable likelihood of the opaque material reaching the alveoli. Furthermore, the procedure is unnecessary for diagnosis.

#### TYPE OF OPERATION USED

With the exception of the first 3 patients, the type of operation which has been used in most of the cases in this series has

consisted of an extrapleural exposure of the anomalous structures, closure of the tracheo-esophageal fistula, and end-to-end anastomosis of the two esophageal segments. This plan has been effected in 26 of 36 patients for whom the operation was undertaken. A roentgenogram of the first case in which the plan was successfully employed is reproduced in Figure 11, A, the operation having been done by one of us (C. H.) on March 15, 1941.

Although the operations in the first patients of this series were done on the left side, a right-sided approach has been used subsequently, because the exposure is thus more easily and safely attained. An extrapleural approach is employed because infants tolerate such exposure much better than surgical procedures which are carried out in the intrapleural space. Temporary leakage at the site of anastomosis may occur postoperatively because of the delicacy of the wall of the lower esophagus and because of unavoidable tension upon the anastomosis. Such leakage is better tolerated if it occurs extrapleurally. With the exception of several of the earlier cases in this series, an endeavor has been made to obtain intrathoracic esophageal continuity in every instance in which it was

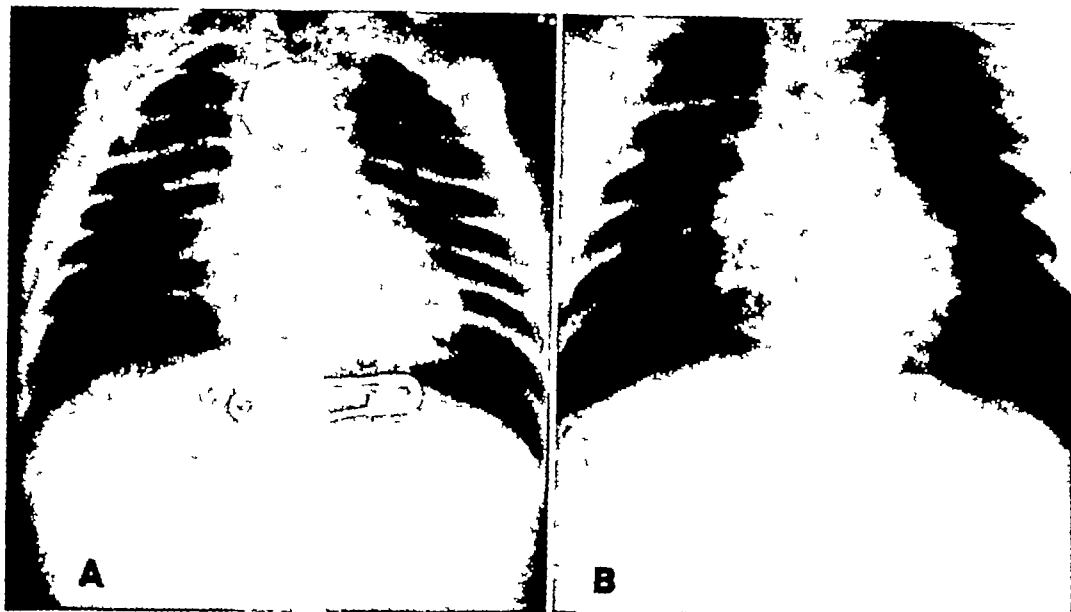


Fig 8 (Cases No 487318 and 498016) Congenital esophageal atresia in two infants. Absence of gas in the stomach and small bowel suggested that an associated tracheo-esophageal fistula was not present, but in each instance a small fistula was found at operation.

The movement seldom exceeds the height of two dorsal vertebrae, although in one instance it extended over the vertical height of the first five dorsal vertebral bodies. Unfortunately, no distal esophageal segment was present in this patient and anastomosis was impossible.

#### *Appearance of Stomach and Small Bowel*

As mentioned in early case reports, the finding of air in the gastro-intestinal tract of infants with complete congenital occlusion of the esophagus clearly denotes the presence of a fistulous communication between the trachea or bronchus and the lower esophagus. Usually the fistula opens into the mid-line of the trachea posteriorly at a distance of from 0.5 to 1.5 cm above the carina, although occasionally the esophagus communicates with the carina or a main bronchus.

Failure to visualize air in the stomach or small bowel has been stressed as a sign which indicates absence of a fistula, but this is not invariably true. In 2 of 5 patients who had no roentgenologic evidence of air in the intestinal tract, a narrow fistula was found at operation (Fig 8).

Unusually pronounced gaseous dilatation of the stomach has been reported as a common clinical and roentgenologic finding in patients with a fistulous communication between the trachea and lower esophagus, but our experience has not proved this to be the rule. Air was present in the stomach and small intestine of 40 of the 45 patients who had preoperative x-ray study, and in only 3 was undue distention of these structures observed. Two of these 3 infants had bilateral pneumonia which may well have been a contributing factor to the distention. Interestingly enough, the patient with the greatest degree of gastric dilatation was the one with a tracheo-esophageal fistula and no esophageal atresia. It should be remembered that the presence of large amounts of air in the gastro-intestinal tracts of newborn infants is entirely physiological.

Hall (28) refers to the possibility of actually observing the stomach distending during inspiration in patients with congenital esophageal atresia and tracheo-esophageal fistula, but states that he could not detect this phenomenon in a case which he reported. We have looked for this sign

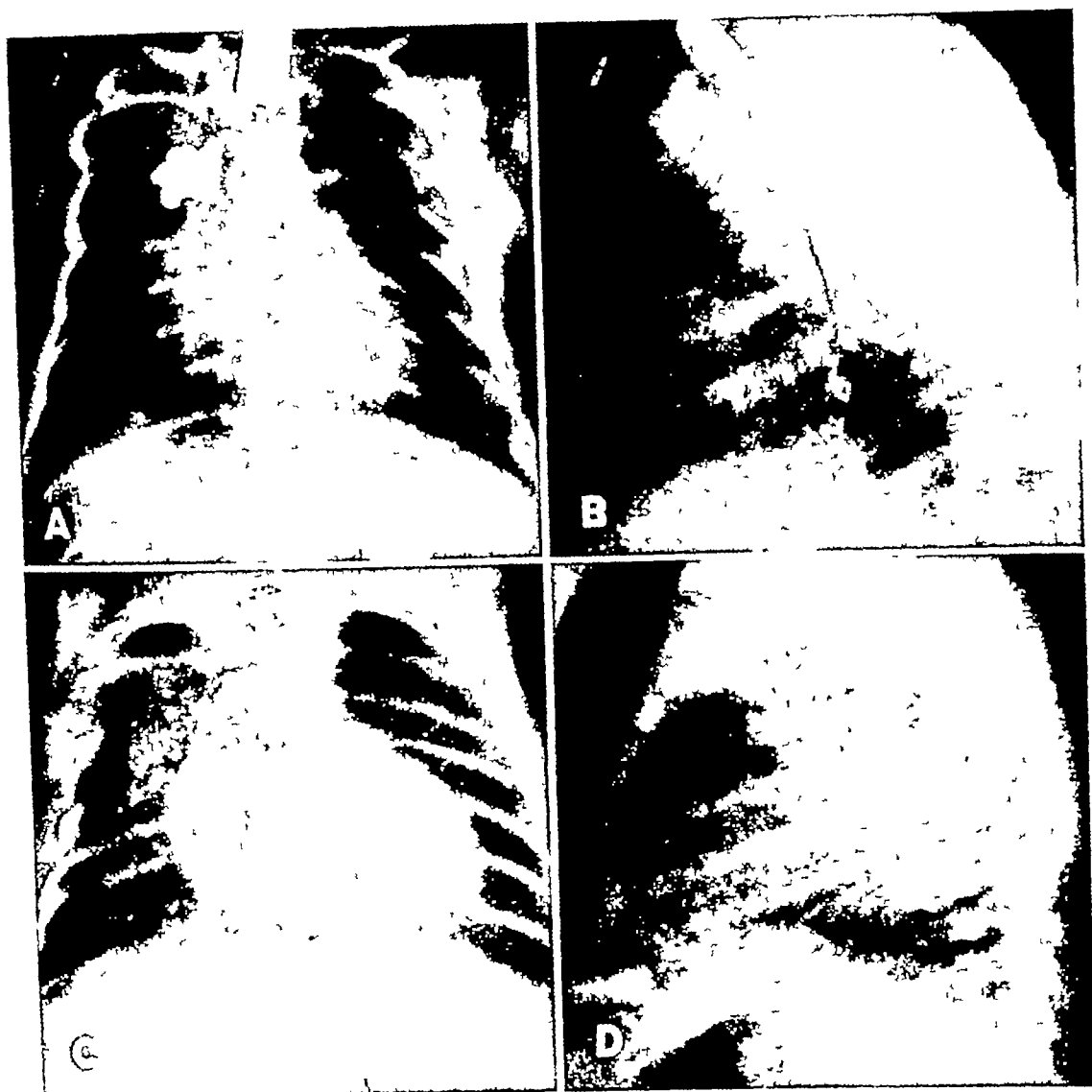


Fig 10 (Case No 560928) A and B Frontal and lateral projections of chest and esophagus three days following repair of esophageal atresia and tracheo-esophageal fistula. Collection of iodized oil at site of anastomosis represents a large local leak. C and D Re-examination six days later, showing definite signs of external esophageal fistula.

case of tracheo-esophageal fistula without esophageal atresia in this group was not diagnosed by roentgenologic methods because the patient was examined only in the supine position.

When either an esophagocutaneous (external) or a recurrent tracheo-esophageal (internal) fistula develops postoperatively, temporary gastrostomy is indicated. In the event that such a procedure is necessary, the position of the gastrostomy tube is checked fluoroscopically. This is done

to avoid the possibility of gastric perforation, which may occur if the tube is inserted too far (3 to 4 cm is optimum).

Periodic examination of the esophagus is employed for determination of the degree of constriction which may occur at the site of anastomosis. A temporary delay in the passage of iodized oil through the esophagus at the anastomosis has been observed in all instances. The delay is on a mechanical basis, as a result of the narrow lumen in this region. In those infants in whom

at all feasible, even at the expense of temporary leakage of the anastomosis. It is our opinion that better physiologic function can be obtained by this method than by multiple-stage procedures for construction of an extrathoracic esophageal tube.

#### POSTOPERATIVE OBSERVATIONS

If a pneumothorax has occurred as a result of accidental opening of the pleura at operation, a bedside film should be made at the conclusion of the procedure. Although it is usually possible to inflate the lung completely at the conclusion of the operation, it should be ascertained by roentgen examination that complete expansion has been obtained. This is desirable from the standpoint of improvement of the infant's breathing and the promotion of early adherence of the pleurae at the site of the opening. If residual air is present in the pleural space (Fig 9, A), it should be removed by aspiration.

Early postoperative pneumonia or atelectasis (Fig 9, B) may escape clinical recognition, yet be clearly discerned on roentgenograms. In rare instances, a pleural effusion has occurred, and this may be of sufficient magnitude to embarrass respiration. As an effusion is best seen on roentgenograms made in the upright position, all bedside films are customarily made with the infant erect.

Examination of the esophagus with the aid of iodized oil is combined with the bedside examination of the chest on the third or fourth postoperative day. With the infant in the upright position, a small amount of oil (1 or 2 cc) is given by mouth from one-half to one minute before the exposure of films. If there is no leakage at the site of the anastomosis and if the oil reaches the stomach satisfactorily, oral administration of fluids in small amounts is begun. Two or three days later the examination is repeated under fluoroscopic control, if the esophagus has remained intact, feedings are rapidly increased in amount.

Distinction should be made between a leak which remains localized to the site of

the esophageal anastomosis and one which results in an external esophagocutaneous fistula (Fig 10). The presence of either does not necessarily condemn the operative correction of the anomaly to failure. An external fistula occurred in 4 of the 9 patients in this series who are living from six months to four and three-quarter years following operation. The fistula closed spontaneously in each instance. Although a stricture developed at the level of the anastomosis in each of these 4 cases, the strictures have responded satisfactorily to dilatation, so that these patients, as well as the other living patients, are receiving all feedings through the reconstructed esophagus.

Persistence of bilateral pneumonitis over a long period of time suggests recurrence of the tracheo-esophageal fistula, or the presence of an additional and unrecognized tracheo-esophageal fistula. Direct evidence of the fistula may be difficult to obtain unless extreme care is exercised in roentgen examination. In this regard, the importance of examining the patient in the prone position following introduction of iodized oil into the esophagus is illustrated by the following case.

A patient in this series developed bilateral pneumonitis postoperatively and it persisted until his death at the age of twenty-five months. Recurrence of the tracheo-esophageal fistula was evident clinically for nine or ten months after esophageal anastomosis, but the fistula appeared to be closing spontaneously. Subsequently, it could not be identified at two fluoroscopic examinations with the patient in the supine position. Failure to visualize the fistula led to the belief that it had completely closed, and the patient was allowed to take all feedings by mouth. The progression of the pneumonitis, however, suggested that the fistula was still patent, and this supposition was finally verified by fluoroscopy. With the patient supine, the fistula could not be seen, but it was immediately evident when an additional swallow of iodized oil was given with the infant lying on his abdomen. Similarly, the one

the anastomosis remained intact following operation, spontaneous enlargement of the lumen occurred as a result of the dilating action of the feedings during swallowing. Actual constriction is particularly apt to occur if there has been an esophageal leak, followed by healing by second intention. Iodized oil has been used for the examination unless it passed through the esophagus too rapidly for accurate evaluation, in which event Rugar provided a more satisfactory means of determining the true width of the esophageal lumen. If dilatation of an esophageal stricture is necessary, roentgen examination again plays an important role in controlling the various dilating procedures and in accurately evaluating the results.

There is considerable variability in the postoperative appearance of the esophagus, not only among different individuals of the group but also in the same patient at different times. Bakwin, Galenson, and LeVine (29) have shown that the normal infant's esophagus is subject to remarkable changes in size and shape, largely due to its inherent distensibility and frequent regurgitation of food from the stomach. When the additional features of congenital malformation and surgical repair are combined with this normal variability, the changes are even more pronounced (Fig 11). It should be emphasized, however, that in all our patients who have been operated upon for esophageal atresia, the vagus nerve has remained intact. Reestablishment of esophageal continuity has, therefore, been accompanied by relatively normal peristaltic action.

On occasion, the esophagus at the level of the anastomosis may be retracted toward the site of the thoracotomy (Fig 11). In our experience, this has happened only when there has been leakage at the site of the anastomosis to the exterior with a resultant large extrapleural wound that healed by second intention. In two patients with an external esophageal leak and a small extrapleural wound, there was no retraction of the esophagus.

Although postoperative defects of the

ribs are clearly visible roentgenographically, there is little or no over-all deformity of the thoracic cage. The resected ribs regenerate promptly and appear to do so in such a manner that the normal shape of the thoracic wall is maintained. Furthermore, dorsal scoliosis resulting from the operative procedure has not been observed.

#### SUMMARY

As the anomaly of congenital atresia of the esophagus has now become amenable to surgical correction, the various methods of roentgen examination have assumed added significance in the diagnosis and management of this condition. Experiences derived from a series of 45 consecutive patients with this anomaly, 42 of whom had associated tracheo-esophageal fistula, are discussed. The findings in an additional patient with congenital tracheo-esophageal fistula but without esophageal atresia are mentioned.

Consideration is given to the roentgenologic measures that are valuable for the establishment of the diagnosis of the anomalies, and for evaluation of any complicating pulmonary lesions which may be present. The importance of roentgen examination and the methods of its use in postoperative management are stressed.

Surgical exploration of the anomaly was undertaken in 36 patients of this group, and intrathoracic reconstruction of esophageal continuity was accomplished in 26. The roentgenologic features of 9 living patients who have survived operation for periods of from six months to four and three-quarter years are presented.

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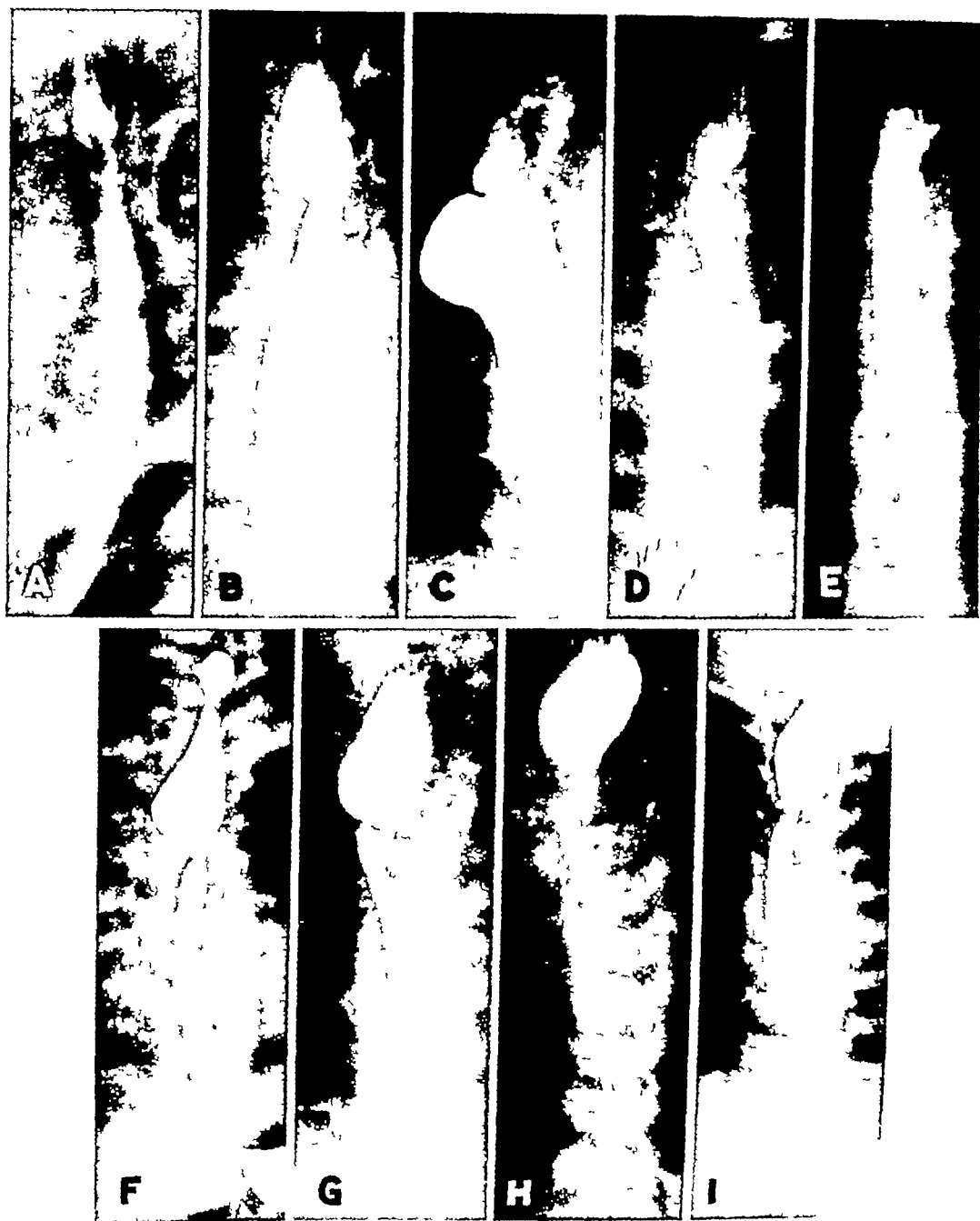


Fig 11 Roentgenographic appearance of the esophagus in each of 9 patients surviving surgical repair of esophageal atresia and tracheo-esophageal fistula A (Case No 477331) Age of patient 4 3/4 years Traction diverticulum is due to adjacent calcified tuberculous adenopathy, which can be faintly seen B (Case No 519-887) Age 34 months C (Case No 522654) Age 32 months Dilatation of esophagus distal to site of anastomosis presumably due to excessive regurgitation and possible localized weakness in esophageal wall D (Case No 528008) Age 30 months The visible metallic clips were used for hemostasis at operation E (Case No 533997) Age 26 months F (Case No 555844) Age 14 months G (Case No 563843) Age 10 months H (Case No 564187) Age 10 months I (Case No 571090) Age 6 months



# Congenital Partial Atresia of the Esophagus Associated with Congenital Diverticulum of the Esophagus

Report of a Case<sup>1</sup>

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THE PURPOSE OF this communication is to put on record and briefly comment upon, with special reference to diagnosis, a condition which does not seem to have been previously recorded, which, in the absence of precedent, has been termed partial atresia of the esophagus associated with congenital esophageal diverticulum

## CASE REPORT

An illegitimate white male child, 12 hours old, born of a 20-year-old primipara after an uncomplicated labor, was admitted to the pediatric service of the Harris Memorial Methodist Hospital in Fort Worth, Texas, June 25, 1941. He was transferred to the hospital from the foundling home to which he had been brought a few hours after birth at a home for unmarried mothers.

He was extremely cyanotic when first seen and had been in this state, it was learned, from the time of his admission to the foundling home. Physical examination revealed no gross abnormalities, and spinal puncture on the third day of hospitalization showed nothing of significance. Meconium was passed per rectum on the second day.

The child improved transiently after the aspiration of a large amount of mucus from the nose and throat, followed by the administration of oxygen, but attacks of cyanosis continued to recur at irregular intervals, and improvement after the measures mentioned was never more than temporary. No oral feedings were given on the first day of hospitalization. On the second day the oral intake amounted to 30 c.c., and on the third day 43 c.c. The nurse reported that the child choked whenever he was fed and that on the fourth day, although he ate hungrily, he promptly vomited all the milk ingested. The rectal temperature during this period ranged from normal to 103° F.

An attempt at gavage on the fifth day was unsuccessful, the tube being stopped by an obstruction after it had been inserted for a distance of 8 cm. Roentgenologic examination (Fig. 1) immediately following this attempt showed the lungs to be clear and the heart shadow normal in size and position. Air was present in the stomach and small intestine, in about the amount usually present in the alimen-

tary canal in newborn children, and this finding was interpreted as indicating communication between the respiratory and gastro-intestinal tracts. A catheter which had been passed into the esophagus had encountered an obstruction at the level of the third dorsal segment, where the tip turned upward. A second examination (Fig. 2), after the injection of a small amount of opaque fluid through the catheter, showed that the esophagus apparently terminated at this level in a smooth, rounded, blind end. On the basis of these various observations, a diagnosis was made of complete atresia of the esophagus, and it was assumed that a fistulous communication between the respiratory tract and the lower segment of the esophagus existed below the level of the atresia.

Gastrostomy was immediately performed under ether (open-drop) anesthesia. The esophagus was closed with a single silk ligature, and the anterior wall of the stomach was sutured to the peritoneum at the edge of the wound. Postoperative measures included parenteral fluids, oxygen inhalations, and aspiration of mucus which continued to appear in the nose and throat. Attacks of cyanosis continued to be frequent. On the third postoperative day the nurse reported that soon after the child had been fed by way of the gastrostomy opening a small amount of the formula could be identified in the mucus aspirated from the throat. Similar observations were made on the fifth and sixteenth days. On two occasions a bariumized mixture was introduced through the gastrostomy tube but roentgen examination failed to reveal any of the opaque medium in the respiratory tract or in the lower portion of the esophagus. On one of these occasions the nurse reported that some of the mixture was later present in the mucus aspirated from the throat.

The child's condition became progressively worse after operation, and death occurred on the twenty-first postoperative day, the twenty-sixth day of life. A purulent discharge from the abdominal wound occurred for five days antemortem. The rectal temperature, which had frequently been 105° F., was normal for four days before death. Abdominal distention was never marked.

The significant findings at necropsy were reported as follows by Dr. John J. Andujar:

*Necropsy.* The child was emaciated, the chest wall being so thin that the individual ribs were

<sup>1</sup> From the Harris Clinic and Harris Memorial Methodist Hospital, Fort Worth, Texas. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

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re opened when the esophageal canal was again empty. These postmortem experiments explained the observations made during life.

(1) No food could pass into the stomach, and none of the injected barium was observed in the stomach, on roentgenologic examination, because the weight of the diverticulum promptly closed the communication between the upper and lower portions of the esophagus as soon as the sac had become weighted down with ingested or injected material.

(2) Gastric contents introduced through the gastrostomy opening could make their way in small amounts through the atretic esophagus and appear in the mucus aspirated from the throat because, when the esophagus and diverticulum were empty, the slit-like communication between the upper and lower portions of the esophagus gaped open. Had the significance of the nurse's observations been realized during life, it should have been possible to reason out the conditions present.

#### COMMENT

Credit for the first description of congenital atresia of the esophagus has been variously assigned. According to Singleton and Knight (13), who attribute their data to Mackenzie in 1880, the anomaly was first observed by Gibson in 1696 and was reported by him in a textbook of anatomy published in 1703. According to Ladd (9), who attributes his data to a publication by Mackenzie in 1884, the earliest observation was made by Durston in 1670 and the first case report was published by Martin in 1821. The confusion is typical of the ascription of credit in many other conditions, and the present writer, since he does not have access to the original literature, merely cites the citations.

Congenital atresia of the esophagus is not a common developmental anomaly. According to Mackenzie (9) 42 cases had been reported by 1880. In 1931 Rosenthal (11) collected 255 cases and added 8 of his own. In 1940 Ashley (1) collected 314 examples to which Ladd in 1944 added 72 cases observed at the Children's Hospital in Boston and made the statement that the number of recorded cases must be approximately 400. Although no attempt has been made by the present writer to collect the recently reported cases, a casual review of titles suggests that the number now on

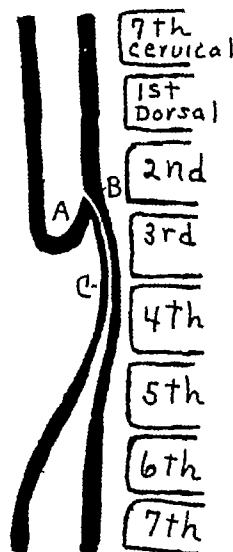


Fig 3 Diagrammatic lateral presentation of congenital partial atresia of the esophagus with esophageal diverticulum A Diverticulum B Slit-like communication between diverticulum and esophagus C Area of partial atresia.

record considerably exceeds Ladd's estimate.

The incidence of congenital atresia of the esophagus varies widely. It has been estimated at 1/50,000 cases but is naturally very much higher in children's hospitals, where the material tends to be highly selective. On the other hand, Fuhrman and his associates (4) did not see a single instance in 12,285 deliveries on the maternity service of the Metropolitan Hospital in New York, where the proportion of autopsies on newborn infants is so high that it was considered unlikely that any cases had been overlooked. The present writer has observed 4 cases, including the one reported in this communication, over a period of twenty-three years. It seems scarcely necessary to emphasize that the relatively large series of cases recorded recently, as compared with the individual cases or small groups of cases formerly reported, merely indicate an increasing awareness of the condition and not a true increase in incidence.

Congenital narrowing of the esophagus, as distinguished from complete esophageal atresia, is apparently extremely rare. Beatty (2), after a systematic search of the literature, could find only 57 cases, includ-

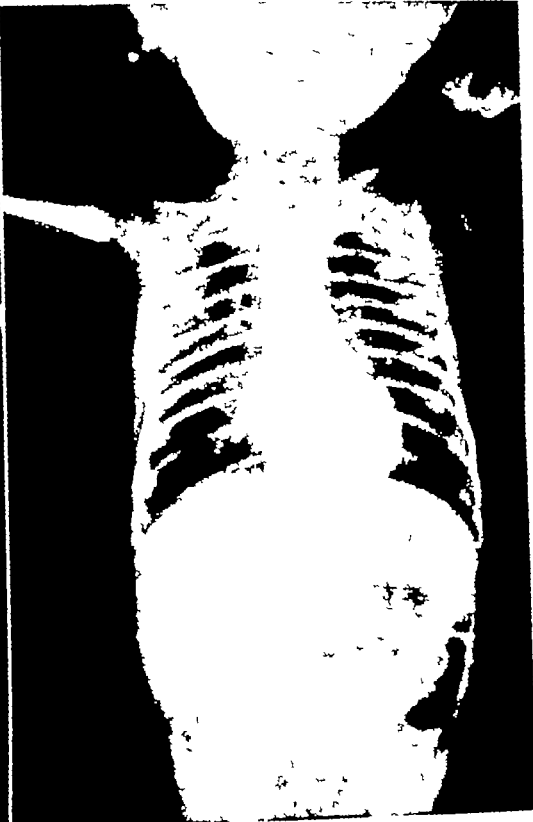
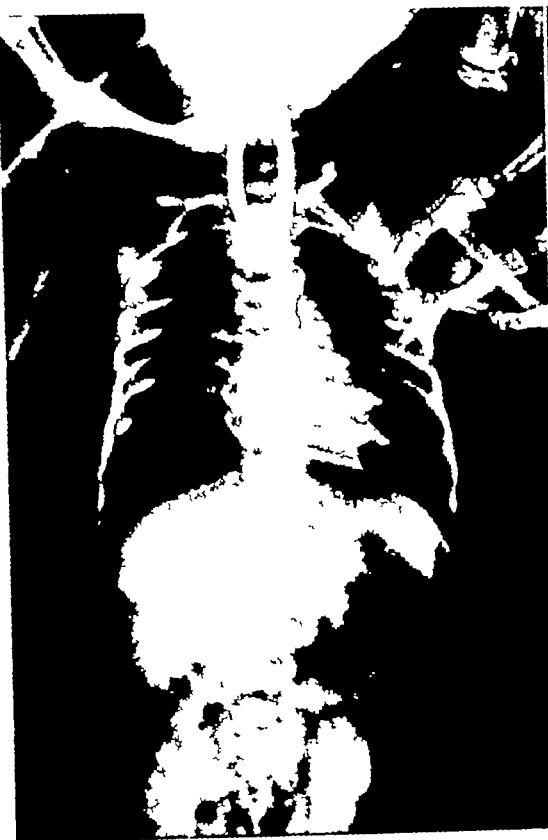


Fig 1 Film showing catheter introduced into upper segment of atretic esophagus, with its tip turned back at the point of obstruction, demonstrated at necropsy to be the inferior aspect of the diverticulum. Note the air in the stomach and small intestine.

Fig 2 Film showing upper segment of atretic esophagus filled with barium and apparently terminating in a blind pouch, demonstrated at necropsy to be a diverticulum.

clearly outlined through it. Examination of the cardiovascular system revealed a patent ductus arteriosus. The peritoneal cavity was riddled with abscesses, the largest being in the pelvis and in the right and the left subphrenic region.

On careful search, no evidence of a fistulous communication between the esophagus and the respiratory tract could be found. The upper third of the esophagus, from the pharynx to the level of the third dorsal segment, was normal except for a uniform slight dilatation. At the point of juncture of the upper and middle thirds (Fig 3) the esophagus ended in a blind pouch. The lower third, which was readily identified by retrograde probing from the gastric side, was normal to the level of the sixth dorsal segment. At this point the esophagus assumed a funnel shape and narrowed sharply. After considerable difficulty it was eventually possible, by the passage of a very thin probe, to demonstrate that the canal continued to the level of the second dorsal vertebra, 1.5 cm above the blind pouch (diverticulum) at which the upper third of the esophagus terminated. At this point the filiform tract communicated with the upper third of the

canal by a slit-like, sharply angulated, oval perforation 0.2 cm in diameter, in the posterior esophageal wall. On the basis of these findings, an anatomic diagnosis was made of congenital partial atresia of the esophagus, associated with congenital esophageal diverticulum.

Section through the esophagus at the level of the diverticulum showed a somewhat thinned-out collagenous stroma, with some round cell infiltration. The lining of the diverticulum was histologically the same as the lining of the stoma of the esophagus which was almost completely atretic at this level.

Before the esophagus was sectioned, a demonstration was conducted, which readily explained the nurse's repeated reports of the presence in the aspirated mucus of food and barium introduced into the stomach by way of the gastrostomy tube, no plausible explanation for this observation had previously been advanced. The esophagus was filled with water, a portion of which passed into the diverticulum. It was then observed that the weight of the filled diverticulum completely closed the slit-like communication between the upper and lower segments of the esophagus, but that it immediately

(agenesis) is extremely rare, and type 3B or 3c occurs in probably 80 per cent of all cases. It will be noted that the case reported in this communication does not fall into any of these classifications.

Beatty (2) classified congenital partial atresia of the esophagus into two groups. In the first, a thin diaphragm of mucous membrane stretches across the interior of the tube and is perforated by an opening varying in size and usually situated eccentrically. In the second type, as in the case reported in this communication (without regard to the presence of the diverticulum), the esophagus is narrowed longitudinally for a variable distance and to a variable degree. All the coats of the esophagus, according to Beatty, are normal in structure, thickness, and histologic aspect, and the anomaly is merely in the size of the canal. In the case reported herewith, the histologic findings varied somewhat from the usual histology of the esophagus.

Until very recently, congenital anomalies of the esophagus were of little more than abstract interest, and Brennemann's (3) opinion, expressed in 1918, was the prevailing one. These children, he wrote, either have bronchopneumonia when they are first seen or it will develop if the anomaly is not corrected. Operation to close the esophagus is not feasible, and in the absence of closure, life, even if it were possible, would be intolerable. The child, for pediatric reasons, could not live even if operation were done, no matter how he were treated. Therefore, after council with the parents, he should be permitted to die as peacefully and as painlessly as possible, and the physician who arrives at that decision has no reason to lose any sleep over it.

The excellent reviews of the literature by Singleton and Knight (13) and by Humphreys (7) indicate that up to the last few years that pessimistic point of view was fully justified. Recent reports of relatively large series of cases (5, 7, 9), however, have completely reversed it. Humphreys' review of 59 operations shows 19 survivals, some for periods of four

years, in addition to 5 survivals reported by Leven in an unstated number of operations. Sixteen of the survivals occurred in cases treated by mediastinal ligation, creation of a cervical stoma, and gastrotomy, in which group Leven's 5 survivals are included, 8 occurred in 25 cases treated by direct anastomosis. Haight (5) later reported an additional survival after operation by this technic. Direct anastomosis, when it is feasible, is the more desirable procedure, the other, as Humphreys notes, offering a considerable problem in reconstructive surgery.

These promising results, of course, cannot be achieved, and surgery cannot be undertaken, in these unfortunate children unless the condition is recognized. Moreover, it must be recognized promptly, for respiratory complications, particularly aspiration pneumonia, develop promptly and are enhanced by the aspiration of gastric contents which pass upward through the esophagus into the lung through the fistula into the trachea. The latter difficulty, because of the atresia present, was not a problem in the writer's personal case, in which pulmonary complications were also prevented by the frequent use of suction to remove mucous secretions. The surgical prognosis, generally speaking, depends upon whether or not pneumonia develops before operation is undertaken. Feeding, as Humphreys (7) emphasizes, is no longer of the importance it once was, since a child who is born fairly well nourished can be kept alive for a long period of time by intelligent parental alimentation.

The diagnosis of congenital atresia of the esophagus should be suspected on clinical grounds during the first few hours of life if the child suffers recurrent attacks of coughing, choking, or cyanosis, and if quantities of mucus are present in the upper air passages and promptly re-accumulate after aspiration. These attacks are exaggerated when fluids begin to be taken by mouth. Clinical diagnosis must be supplemented by roentgenologic methods, to determine the type of anomaly present.

ing 2 personally observed examples, reported up to 1928. In his communication he noted that only 2 instances were observed at the London Hospital in 13,201 necropsies performed between 1907 and 1921. He also noted that Hirschsprung, who selected congenital narrowing of the esophagus for the subject of his thesis for his medical doctorate in 1861, in spite of his interest in the subject did not have a single case under his care until thirty-four years later. Whether all of the cases collected by Beatty were instances of congenital narrowing of the esophagus is perhaps open to doubt, since his series included not only infants but also children and adults, one of whom was eighty-four years of age.

To the very unusual instance of congenital partial atresia of the esophagus reported in this communication must be added the even more unusual presence, in association, of a congenital esophageal diverticulum. So far as can be determined by a search of the titles in the recent literature, as well as by the investigation of numerous individual articles, this is only the second instance of the latter congenital anomaly to be reported. It occurred, furthermore, in a newborn child, whereas the only other instance on record, reported by Jackson and Shallow (8) in 1926, occurred in an eight-year-old child, though there seems to be no doubt that it also was congenital. The case of esophageal "diverticulum" reported by Holderman (6) in 1927, in association with congenital atresia of the esophagus and tracheo-esophageal fistula, seems from the description and illustrations to be an instance of faulty nomenclature, the so-called diverticulum apparently being merely the blind upper end of the atretic esophagus.

The multiplicity of abnormalities represented in the reported case, namely, partial atresia of the esophagus, diverticulum of the esophagus, and patent ductus arteriosus, is not at all unusual. In Holderman's (6) case, for instance, the child, in addition to the esophageal anomalies, had 13 ribs on each side and a double uterus.

Poth (10) reported a case of patent ductus arteriosus associated with congenital atresia of the esophagus. In 49 of Ladd's (9) 72 cases the esophageal anomalies were associated with one or more other abnormalities, which involved the heart and aorta in 10 cases and which in many instances were incompatible with life. In Humphreys' (7) series of 27 cases only 10 associated anomalies were present, and in only one case were they of sufficient severity to influence the outcome, but this is not the usual experience.

In this connection certain privately published data collected by D P Murphy (12) are of interest. His study of 890 congenital malformations led him to the following conclusions. Malformation of some sort occurs in 1 of every 213 individuals born alive. The incidence is twice as high in white as in Negro children. Almost a quarter of malformed children present more than one anomaly. The frequency of birth of a subsequent malformed child is 25 per cent greater in families already possessing a malformed child. The older the mother, the greater is the possibility of a malformed offspring. Approximately 25 per cent of all malformed children are stillborn, and about 90 per cent, including those born dead, do not live beyond the first year. Ignorance of the family history in the case reported herewith prevents comment upon these conclusions in relation to it.

Of the several classifications of congenital anomalies of the esophagus, Vogt's (15) is the simplest and most useful. It can be summarized as follows:

- 1 The esophagus is completely absent.
- 2 The upper portion of the esophagus ends in a blind pouch in the region of the first or second dorsal vertebra. The lower segment originates in a blind pouch at the level of the fourth or fifth dorsal vertebra.
- 3 The esophagus is atretic, as in type 2, and communicates with the trachea (A) by way of the upper segment, or (B) by way of the lower segment, or (C) by way of both segments.

Complete absence of the esophagus

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The upper segment of an atretic esophagus can easily be demonstrated by the passage of a catheter down to the point of the obstruction, followed by the injection into the tube of a few cubic centimeters of air. The lower segment of an atretic esophagus is much less easily demonstrated. In occasional cases it may be outlined by air regurgitated from the stomach in the course of the examination, but the coincidence obviously is purely accidental and cannot be relied upon. Tucker and Pendergrass (14) described a method by which an opaque medium is introduced into a ureteral catheter which has been passed down a bronchoscope through the fistula in the trachea into the lower esophageal segment. Even with this precaution, however, the use of a contrast medium seldom furnishes enough additional information to compensate for the risk its use involves. If it is used, bland iodized oil is preferable to a barium mixture, and whatever material is used should be promptly removed, to prevent its entrance into the lower respiratory tract.

It is generally accepted that the demonstration of a blind upper esophageal pouch by means of air or of an opaque medium is diagnostic of esophageal atresia, with or without communication with the trachea, while the presence of air in the gastrointestinal tract is diagnostic of a communication between the lower segment of an atretic esophagus and the trachea, or of both esophageal segments and the trachea. The case reported herewith suggests that this conclusion should not be accepted without reservations. The apparent demonstration of a blind termination of the upper esophagus, plus the presence of air in the gastro-intestinal tract, fulfilled the diagnostic criteria for atresia of the esophagus with a tracheo-esophageal fistula, but the conclusion, as necropsy proved, was in error. The nurse's observation, as already pointed out, of gastric contents in the mucus aspirated from the upper air passages was the clue to the diagnosis, and, if properly appreciated, might have

led to a theoretic reconstruction of the conditions present. Gastrostomy, which was done as a palliative procedure, did no harm under the circumstances, but a more extensive operation might readily have led to a faulty correction of the anomalies. The child could probably not have lived, regardless of what was done, because of the extent of the atresia, though the correction of the esophageal diverticulum was perfectly feasible.

In retrospect, it seems that esophagoscopy might have contributed to the diagnosis in this case, by demonstrating the slit-like opening, which would have suggested the presence of the atretic area. The routine use of this method in all presumptive atresias of the esophagus would do no harm and might be of considerable diagnostic value.

#### SUMMARY

There is put on record the case of an infant seen twelve hours after birth with a train of symptoms and signs suggestive of congenital atresia of the esophagus with tracheo-esophageal fistula and managed on that assumption. Autopsy revealed the presence of two congenital anomalies of the esophagus which do not seem to have been reported previously in combination and which do not fit into any of the classifications which have been suggested. In the absence of precedent, the condition has been termed congenital partial atresia of the esophagus associated with congenital diverticulum of the esophagus. The literature indicates that partial atresia of the esophagus is very rare, and, so far as can be determined, this is only the second instance of congenital diverticulum of the esophagus to be recorded. No record of a similar case could be found.

Diagnostic considerations are discussed, and their importance is emphasized in view of the great improvement recently achieved in the surgery of congenital esophageal anomalies.

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if any effect is to be produced by the x-ray

(c) A latent period of several hours is present before the x-rays are effective

(d) The period of effectiveness of the x-ray is apparently limited, and this period of limitation may depend on factors not yet understood. In the dosage commonly used in infections, it is between the second and the seventh to tenth day

(e) This antitoxic effect is apparently non-specific in character

Other experimental data tending to support the work of the foregoing observers, but usually interpreted to the contrary, follow

*Irradiation of Toxins in vitro* The antitoxic effect of the x-ray in patients in the advanced stages of gas infection was so striking that it led us to attempt to neutralize toxins *in vitro*. With no variation in our technical procedures, however, were we able to influence the strength of the toxin *in vitro*. Since it appears that the antitoxic factor is produced by the tissues of the irradiated animal, and as such tissues are absent in this type of experiment, this result was to be expected

*Irradiation of Bacteria in vitro* It was agreed by the early research workers that the pathogenic tendencies of bacteria when irradiated *in vitro* were not affected by radiation in amounts which were much beyond the dose range employed therapeutically for infections. Since no tissues are irradiated in these experiments, no antitoxic factor is produced, and, therefore, no effect of irradiation on bacteria can be expected

Experiments such as the two discussed above have been interpreted by Weed *et al* (9) and Erb and Hodes (10) as evidence that x-rays are of no value in treating gas gangrene, whereas actually they add to the already convincing evidence that living tissue must be present if antitoxin is to be liberated. At any rate, it should be obvious that the conditions under which these experiments are carried out are so far removed from those present in the treatment of infected tissues in man that no certain interpretation as to the value of x-rays in that respect seems warranted

*Irradiation of Small Animals Which Live Only a Few Hours after Inoculation* The failures in this type of experiment (Caldwell and Cox, 11, Singer, 12, Kelly *et al*, 13-15) also support the conclusion that time is a factor in the production of the antitoxic effect. Unless the small animal, which is very susceptible to the toxins, is irradiated some time prior to inoculation, as shown by Bisgard *et al* (8), it will die in a few hours. Such results lend support to the research work which shows that twenty-four to forty-eight hours must elapse before the antitoxic factor becomes effective

*Irradiation of Larger Animals* Merritt, Den, and Wilcox (16), using sheep at the suggestion of Dr Sarah Stuart of the National Institute of Health, Washington, D C, inoculated the animals with a strain of *Cl welchii*, designated as S R 12, the same organism used by Weed (9), and proved everything in these experimental animals that had been claimed for the use of x-rays in treating gas gangrene in man, namely, that they localized the infection, thereby conserved tissue, lessened the toxemia, and lowered the mortality. Although toxins, as well as organisms, were introduced at the time of the inoculation, these larger animals are apparently able to withstand the shock associated with this procedure for a sufficient length of time to permit their cells to respond to the x-rays and produce their own life-saving antitoxin. Such has never been the case with small animals irradiated after inoculation, these die in a few hours, before the x-rays have time to take effect

From the foregoing experimental data, it is obvious that certain factors must be present in order to secure the beneficial effects of irradiation in the prevention of wound infection or the treatment of acute toxic infections such as gas gangrene—the tissue factor, the dose factor, and the time factor

(a) *The Tissue Factor* Since the beneficial effect of x-rays is dependent on the liberation of an antitoxic substance formed in the tissues, living cells must be irradi-

# Röntgen Rays in the Prevention and Treatment of Infections<sup>1</sup>

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**I**MMEDIATELY after the discovery of x-rays by Roentgen, the study of their effects on various infections was started and thus has continued to the present day. At this time, a brief review of the available experimental and clinical data will enable one to appreciate how closely these observations parallel and support one another in their most important aspects. When this is done, a better understanding of the entire problem is certain, and much of the confusion, real or assumed, of the last few years is eliminated.

## EXPERIMENTAL STUDIES

As early as 1904, Heineke (1) had shown that many cells react to roentgen rays and that there is an elective action of the rays upon the lymphoid tissues. This was corroborated by Warthin (2) in 1906. Later Desjardins (3) and Pordes (4) also made investigations in this field and expressed the belief that the striking effect of radiation in inflammation is due to the early destruction of the leukocytes, which set free protective ferments, antibodies, and other substances at the site of inflammation more quickly than occurs normally in the natural course of inflammation.

Heidenhain and Fried (5) brought out by serological experiments that these cellular changes are associated with an increase in antibodies in acute infections and proved that the exposure of patients to roentgen rays is followed by a direct increase in the bacteriolytic power of the blood lasting from two to six days. Thus, many years ago, there was experimental evidence that x-rays acted on living cells and caused an increase in antibody formation.

In 1940, Altmeier and Jones (6) reported their observations on the prevention of peritonitis in rabbits by x-rays.

This study was undertaken because the authors had observed an immunity against peritonitis in patients who had received irradiation prior to surgery for cancer of the rectosigmoid. They thought this effect of the rays was non-specific, since many organisms were involved, but no infection of any kind occurred. They offered no explanation for the results they obtained. Rigos (7), however, treating experimental peritonitis in guinea-pigs, noted differences in cell changes at various periods after irradiation. Further studies along this line may produce an explanation for the observations of Altmeier and Jones, who had found evidence of immunity some weeks after irradiation.

Bisgard, Hunt *et al* (8), in 1942, reported work which showed beyond any question that x-rays exerted an antitoxic effect on toxins of bacterial origin, that through this antitoxic effect some degree of immunity could be established for a time, that the antitoxic effect was non-specific in character and that a latent period of a few hours was present before the x-rays were effective.

Thus throughout a period of practically forty years, there has been a worth-while consistency in the findings of many research workers in this field to support the contention of many clinicians that x-rays are of value in the prevention and treatment of infections.

Among the significant facts brought out by these research workers are the following:

(A) After irradiation with x-rays, the lymphocytes and probably other cells give off a protective or antitoxic substance effective against toxins of bacterial origin.

(B) Since the lymphocytes and probably other cells give off this antitoxic substance following irradiation, it is obvious that the presence of living tissue is essential.

<sup>1</sup> Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov 9-10, 1945.

if any effect is to be produced by the x-ray

(c) A latent period of several hours is present before the x-rays are effective

(d) The period of effectiveness of the x-ray is apparently limited, and this period of limitation may depend on factors not yet understood. In the dosage commonly used in infections, it is between the second and the seventh to tenth day

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From the foregoing experimental data, it is obvious that certain factors must be present in order to secure the beneficial effects of irradiation in the prevention of wound infection or the treatment of acute toxic infections such as gas gangrene—the tissue factor, the dose factor, and the time factor

(a) *The Tissue Factor* Since the beneficial effect of x-rays is dependent on the liberation of an antitoxic substance formed in the tissues, living cells must be irradi-

ated Therefore, a fairly large area of tissue should be treated

Kaplan (17) emphasized the necessity for irradiation of tissue in his recent excellent review by stating "The associated living tissue activity is essential for the production of the curative effect of irradiation, and for this reason the theories based only on laboratory test-tube investigation are not entirely applicable to human conditions"

(b) *The Dose Factor* Since the beneficial effect of x-rays on the tissues is not apparent until a certain amount of irradiation has been given, and this effect is not increased beyond a certain point, regardless of how great the amount administered, it is evident that a proper dose of x-rays is essential This dose varies under different circumstances

(c) *The Time Factor* Since several hours must elapse before the irradiated cells liberate the antitoxic substance, a required period of time must be allowed to elapse before any beneficial effect of the x-rays is to be expected, they are apparently not effective beyond the seventh day

When any of these essential factors is absent, no beneficial effect of the x-rays appears, as shown by the experiments just discussed, demonstrating the failure to neutralize toxins *in vitro*, the failure to influence the pathogenic effect of bacteria *in vitro*, and the failure to cure those research animals which die in a few hours after inoculation or are inoculated or become toxic after the period of effectiveness has passed

On the other hand, when the three essential factors are present, the following important conclusions are fully supported by the experimental evidence

(a) An antitoxic factor against toxins of bacterial origin is developed by irradiation of living tissue

(b) This antitoxic factor is non-specific in character and, therefore, is of value in prophylaxis and treatment of many infections during the period of its effectiveness, which is from the second to about the seventh day

## CLINICAL STUDIES

In any clinical application of x-rays for the prevention or treatment of acute infections, it is obvious that two of the essential factors (living tissues and x-rays) are always present, at least in some degree, while the third, the time factor, may or may not be present, since the patient may die shortly after the x-ray treatments are started

(a) *The Tissue Factor* Whether or not some of the failures in the clinical application of the rays may be attributed to an error in the amount of tissue irradiated is not easily determined, but it has been the observation of many radiologists that when a fairly large area, including some normal tissue about the region infected, was irradiated, the best result was secured

That the tissues of man produce an antitoxic substance similar to that produced in Bisgard's experiments on rabbits is evident clinically and statistically from the observations made on the treatment of gas gangrene This disease is selected for comparison because it belongs in that group of toxic infections for which claims have been made for the value of x-rays in prevention and treatment and because more complete data are available in the literature on this than on any other infection

Clinically, the antitoxic effect (15, 18, 19, 20) of the x-rays in a well established gas infection is so impressive that it cannot be missed by anyone Statistically, there is a consistently lowered mortality rate in the various clinical types of gas infections which received no commercial antitoxin as compared with the cases treated with the addition of commercial serum The very lowest mortality recorded, 4.34 per cent, was in a group of 46 cases receiving three or more x-ray treatments and no commercial serum (15) Thus, it is evident clinically and statistically that, whether or not an antitoxic substance is produced in human tissues as a result of x-rays, the effect with x-rays is essentially the same or better, which is the important fact for any clinician As a rule, no commercial serum is necessary

if x-rays are used. In fact, if x-rays are used in the suspected or early stages of the disease, there is an advantage in omitting commercial serum and depending upon the patient's ability to develop his own antitoxin.

There is, however, an exception to this general rule. We refer to the patient in whom gas infection follows a hypodermic injection (20). In such cases death often ensues so promptly (because toxin is quite likely introduced at the time of injection) that, if commercial serum is immediately available, it should obviously be used in the hope that it may match the invading bacteria and therefore have some effect in the early hours of the disease before the x-rays become effective. We have felt for some time that the multiplicity of organisms involved in so-called gas gangrene is the main difficulty which prevents the preparation of a serum producing consistent results. Serum, if available, might also be used for the patient with advanced disease who has had no x-ray therapy and who looks as though he might die in a few hours, before x-rays have a chance to produce any antitoxic effect in the tissues. Only a moderate dose of commercial serum should be used in any instance.

One would expect an autogenous serum to be free of any toxic reactions such as often follow the use of commercial serum, and this appears to be the case, as no serum sickness was observed in patients who received x-ray treatment alone, while it is a common occurrence in those who are given commercial serum. At any rate, it is universally acknowledged that the ideal means of prevention or treatment of a lethal infection, such as diphtheria or tetanus, is the use of an effective serum, therefore, what could be more desirable than to use x-rays to produce from the patient's tissues a non-specific antitoxic factor effective against an acute toxic infection, regardless of whether it is called an autogenous serum, an antitoxin, or by any other name? If suspected and early cases received x-ray therapy, the occasion for using any commercial serum would be rare indeed. Fur-

ther investigation may show that it is never needed under any circumstances, even for those we have suggested as possibilities.

(b) *The Dosage Factor* Experimentally and clinically, it seems that a filtered (filter for safety) dose of x-rays, totalling about 100 r, is adequate, and the number of doses will depend on the clinical course of the case. They are usually given at twelve- to twenty-four-hour intervals through a period of one to five days. Since many variations in the amount of tissue irradiated and in the dosage given are evident in clinical reports on the successful treatment of numerous types of infection, it is obvious that the exact technical requirements to assure the best effect from the use of the first two essential factors are not so sharply defined as in the case with the third, the time factor.

(c) *The Time Factor* The importance of the time factor and its lack of latitude if success is to be obtained is clearly demonstrated in the clinical reports available for analysis in gas gangrene. The technic we recommended called for a treatment every twelve hours. Our statistics (18) show that among those who lived only long enough to receive one treatment (twelve hours) the mortality rate (48.27 per cent) is essentially the same as in the A E F, in World War I (48.52 per cent). Those who lived long enough to receive two x-ray treatments (over twenty-four hours) showed a mortality of 28.94 per cent, and among 288 who lived long enough to receive three or more treatments (over thirty-six hours), the mortality dropped to 5.9 per cent.

It is evident, from the foregoing figures, that little or no effect was secured in the early hours after irradiation was begun, but after twenty-four hours the effect was good, while after thirty-six to forty-eight hours it was tremendous. This is what would be expected from the experiments showing that time is a factor in the development of the antitoxic effect. This clinical observation led us to demand early treatment, even before the disease becomes fully established if the best results are to be

secured. In fact, we stated that all contaminated wounds in which a gas infection might be expected to develop should be given a prophylactic treatment each day for three days. We have done this for years and have never had a gas infection develop following this procedure. As a guide to the type of case in which x-ray prophylaxis is indicated, we have stated that any patient thought to need antitoxin to protect against tetanus should also receive x-rays to protect against gas and other rapidly growing organisms.

That it is essential, however, to give antitoxin to protect against tetanus and not to depend on x-rays was determined very early in our study by the occurrence of tetanus in patients recovering from gas gangrene after irradiation. Tetanus may occur in the third and fourth week and apparently is not prevented by the x-ray therapy given for gas infection during the first week. This also supports the observation that the immunity following x-ray therapy does not extend so long (Fig 1) or is not effective at that time.

Thus, there is clinical as well as experimental evidence that the time factor is essential. The death rate was the same in patients who received only one x-ray treatment as it was in those who received no x-ray therapy, usually because they died before it was time for them to receive their second treatment, or in the first twelve hours, while those who lived into the twenty-hour and thirty-six-hour periods, when the antitoxic effect was present, showed remarkable response to irradiation. The occurrence of tetanus in patients who were treated with x-rays and recovered from gas gangrene also confirms the experimental data which show that the effectiveness of the antitoxic substance formed as a result of x-ray therapy does not extend beyond about the seventh day.

The non-specific character of this antitoxic factor, proved experimentally by Bisgard and his colleagues, has also been evident clinically for many years in the treatment of erysipelas, surgical mumps, pneumonia, and other acute toxic infections, as well as

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GOLDMAN, L. B. Irradiation in Infections New York State J Med 42 1341, July 15, 1942	5	1
	58	7

In this recent series of 58 cases with 7 deaths, the mortality rate is 12 per cent, which is less than 1 per cent higher than the mortality of 11.7 per cent for 392 previously collected cases of post-traumatic gas gangrene.

in the treatment of gas gangrene and acute spreading peritonitis following appendicitis. Reports on the x-ray treatment of these various diseases extend over too long a period of time and come from too many sources to warrant any legitimate doubt as to their authenticity or their accuracy.

*Consistency of Clinical Data on Gas Gangrene.* Our report (15) in 1941 showed in Figure 2 and Table III a total of 392 cases of post-traumatic gas gangrene from various sources, with 46 deaths, or a mortality of 11.7 per cent. A recent hurried review of papers published in English and listed in the *Quarterly Cumulative Index Medicus* and available to the writer (see Table I) brought out 9 more reports (from entirely new sources) totalling 58 cases, with 7 deaths or a mortality of 12 per cent, less than 1 per cent difference from the former mortality rate.

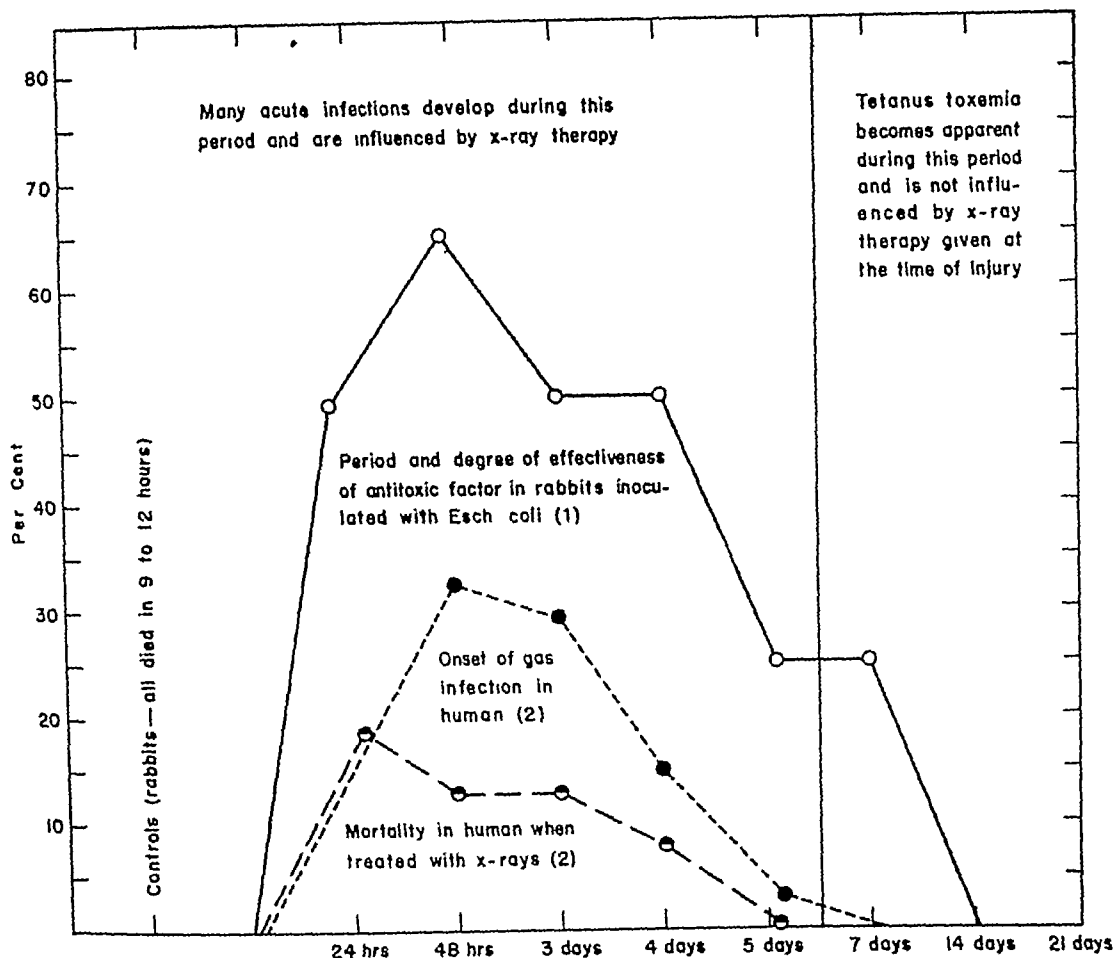


Fig 1 From this composite graph, it is obvious that if x-rays for prophylaxis are given soon after the injury occurs, the period of protection begins in a few hours and continues for several days beyond the time a gas infection is likely to develop. Since the antitoxic factor is non-specific in character, it is also evident that the danger of infection from many other organisms is also eliminated or greatly minimized by irradiation.

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All of these reports make a total of 450 (post-traumatic) cases, with 53 deaths, or a mortality rate of 11.8 per cent. There is a consistency in these reports, from widely separated sources, which, regardless of what happens in animals, establishes this study as a completed clinical experiment, and there is such a thing as a clinical experiment, in spite of any number of opinions to the contrary expressed by professional animal research workers.

**Prophylaxis** The use of the x-rays in the prevention of gas gangrene and other types of wound infection has been previously advocated (15, 18, 20, 21, 22), and there is no reason at this time to modify our

belief in the procedure. In fact, all experimental and clinical work supports it so strongly that it seems mandatory that radiation therapy be used for prevention of infection in contaminated wounds.

Finally, the works of Bisgard and Riggs bring out nothing to disprove our contention that x-ray therapy is effective in acute spreading peritonitis. We feel that many people are much better off producing their own antitoxin after radiation therapy than they would be in attempting to live after the peritoneal cavity has been assaulted by the application of various sulfa powders and crystals, which, at the best, are only bacteriostatic agents and not to be com-

secured In fact, we stated that all contaminated wounds in which a gas infection might be expected to develop should be given a prophylactic treatment each day for three days We have done this for years and have never had a gas infection develop following this procedure As a guide to the type of case in which x-ray prophylaxis is indicated, we have stated that any patient thought to need antitoxin to protect against tetanus should also receive x-rays to protect against gas and other rapidly growing organisms

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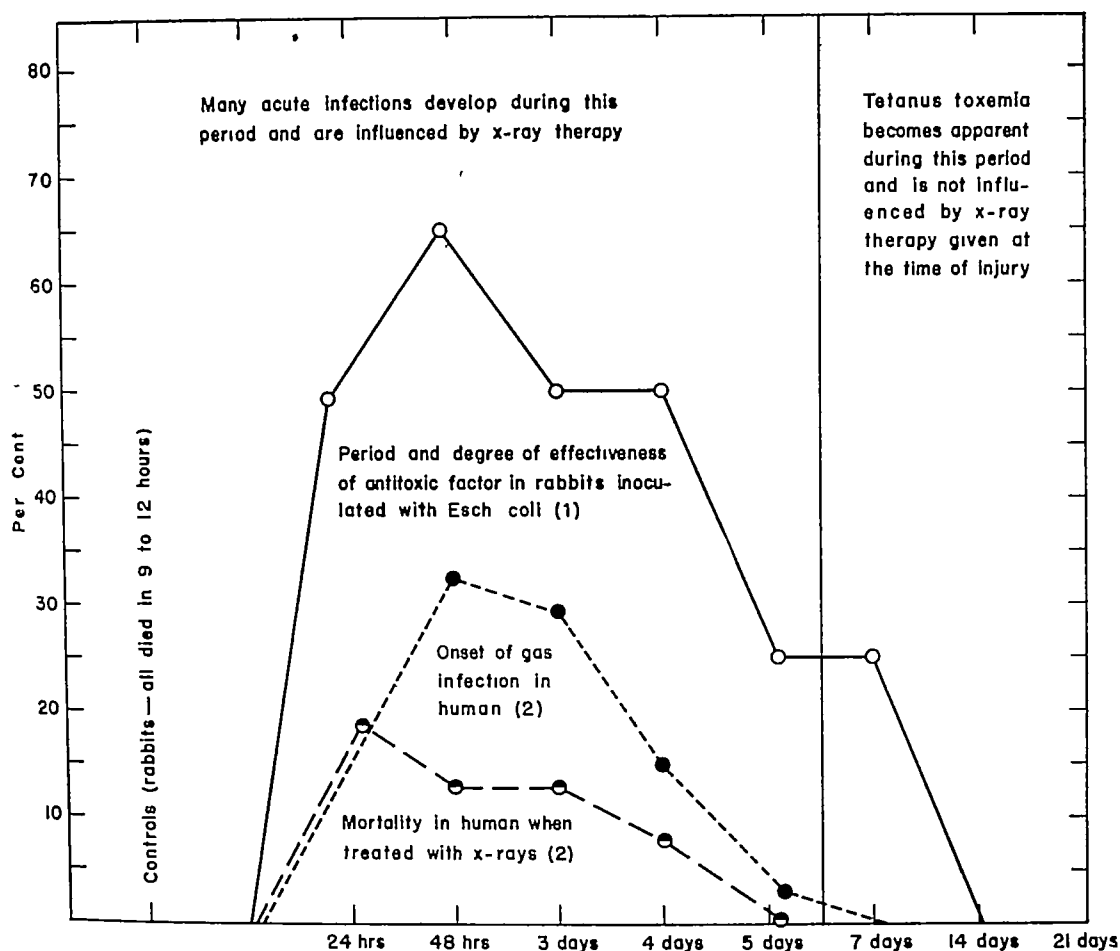


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pared in value with an effective antitoxin free of any confusing reactions or serious complications. Bisgard's work, proving the absence of any antitoxic action from the use of the sulfa drugs and Meleney's report (23, 24) on the work of the National Research Council Committee on Wound Infection, in which investigation it was shown that these drugs were ineffective in preventing wound infection, should leave little doubt as to which method to use. X-rays will bring about both of these results (prevent wound infection and produce an antitoxic factor) as well as hold unpleasant or dangerous reactions to the minimum.

*Period of Immunity with Relation to Secondary Infection.* The usual period of onset of infection with streptococci or the gas-forming group following injury is well covered by the period of immunity obtained from x-ray therapy (see Fig 1), and our observations have led us to believe that any infection from the rapidly growing organisms will be prevented if x-rays are used for the first three days after injury. As a result of this effect, it appears that other more slowly growing organisms are not able to establish a growth, thus the so-called secondary infections, usually radioresistant, are also eliminated indirectly by this prompt effect of the x-rays on the early invaders.

*Recovery of Tissues After Use of Specific Antitoxin.* The effect of the specific antitoxin for diphtheria and the effect of the antitoxic substance formed in the tissues following radiation show no appreciable difference. Diphtheria antitoxin will prevent the onset of diphtheria, and there is considerable evidence in the literature that the use of the x-rays following an injury such as is commonly associated with a gas infection will prevent the onset of that complication.

It is also common knowledge that tissues badly involved in a well developed case of diphtheria show prompt improvement with a minimum of local destruction after administration of the antitoxin. A similar recovery of tissues is noted in gas gangrene

after x-ray therapy, sometimes the recovery has been complete when the tissue seemed hopelessly diseased. *Those who assume that there is no known method for the prevention and the treatment of gas gangrene are in error. The most important fact, however, is that the x-rays will not only prevent gas gangrene, but will also prevent many other infections if used early.* Incidentally, and of some importance to the patient, when x-rays are used for the prevention or treatment of wound infection, it is not necessary to remove the involved tissues unless they are hopelessly destroyed. There is no justification for the removal of tissues under suspicion of involvement or only slightly involved, though it is a common surgical practice at this time.

The value of x-rays when they are used early for prevention of wound infection cannot be overemphasized. Specific antitoxins are the ideal means of preventing and treating infections, and, therefore, no measure could be more satisfactory from every angle than to have the patient produce his own antitoxin, which is non-specific in character and active at the time when the majority of infections from contamination are likely to appear. It is simple and safe to produce and costs little. The dangers from such application of the rays are less than the dangers associated with many other forms of prophylaxis or therapy. If there is a justifiable reason for not using x-rays for the prevention and treatment of wound infection, it has not been proved up to this time.

*Tetanus.* It seems probable that with a little study of the space factor and other technical details of administering the x-rays, tetanus may also be prevented, but at the present time reliance must be placed on tetanus antitoxin and it should be used in all instances.

*Sulfonamides. The Only Recognized Contraindication.* The ability of sulfonamides to alter or to inhibit the effect of x-rays is apparent from both clinical and experimental observations (25-32), and the attempt to combine the sulfa drugs and x-rays to produce a beneficial effect is to be

thoroughly condemned. Any attempt to judge the effect of either agent when they are combined is also to be condemned. The mortality may not be increased to any great extent, but the morbidity, as shown by increased number of necessary amputations, is definitely high, and more x-ray therapy will be required to secure even a fair result in cases where small doses and lower kilovoltages would suffice if the drug were omitted.

*Penicillin* Since penicillin is a biological product, there is no contraindication to its use with x-ray therapy. Why penicillin is so often referred to as a chemotherapeutic agent is not clear.

#### SUMMARY

A review of the experimental work on the effect of roentgen rays in infections over the past forty years reveals certain findings with such consistency as to establish them as facts. A review of clinical reports over the same period reveals certain observations which are in agreement with the experimental findings with such consistency as to establish the same facts. From these facts, based on experimental and clinical proof, the following conclusions seem indicated.

The use of x-rays for prevention and treatment of certain acute infections requires the presence of three essential factors: (a) the dosage factor, (b) the tissue factor, and (c) the time factor. When these factors are present, a non-specific antitoxic substance is created in the tissues after a few hours which is effective for several days.

From the foregoing experimental and clinical data, a law of roentgen irradiation effect on certain pathogenic organisms may be postulated as follows:

When an area of living tissue receives an adequate dose of roentgen radiation, non-specific antibodies are liberated after a period of some hours which, depending on the time of irradiation, will either prevent or cure certain infections having a short incubation period, provided no chemical

agents are used simultaneously which inhibit or alter the effect of the rays.

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# Radiological Use of Fast Protons

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EXCEPT FOR electrons, the particles which have been accelerated to high energies by machines such as cyclotrons or Van de Graaff generators have not been directly used therapeutically. Rather, the neutrons, gamma rays, or artificial radioactivities produced in various reactions of the primary particles have been applied to medical problems. This has, in large part, been due to the very short penetration in tissue of protons, deuterons, and alpha particles from present accelerators. Higher-energy machines are now under construction, however, and the ions from them will in general be energetic enough to have a range in tissue comparable to body dimensions. It must have occurred to many people that the particles themselves now become of considerable therapeutic interest. The object of this paper is to acquaint medical and biological workers with some of the physical properties and possibilities of such rays.

To be as simple as possible, let us consider only high-energy protons; later we can generalize to other particles. The accelerators now being constructed or planned will yield protons of energies above 125 Mev (million electron volts) and perhaps as high as 400 Mev. The range of a 125 Mev proton in tissue is 12 cm, while that of a 200 Mev proton is 27 cm. It is clear that such protons can penetrate to any part of the body.

The proton proceeds through the tissue in very nearly a straight line, and the tissue is ionized at the expense of the energy of the proton until the proton is stopped. The dosage is proportional to the ionization

per centimeter of path, or specific ionization, and this varies almost inversely with the energy of the proton. Thus the specific ionization or dose is many times less where the proton enters the tissue at high energy than it is in the last centimeter of the path, where the ion is brought to rest.

These properties make it possible to irradiate intensely a strictly localized region within the body, with but little skin dose. It will be easy to produce well collimated narrow beams of fast protons, and since the range of the beam is easily controllable, precision exposure of well defined small volumes within the body will soon be feasible.

Let us examine the properties of fast protons somewhat more quantitatively. Perhaps the most important biological quantity is the specific ionization, or number of ions per centimeter of track. This quantity is not difficult to calculate. The results of such calculations are shown in Figure 1, where the range of protons in tissue is plotted for protons of various energies. In the same figure, the specific ionization is plotted as a function of the range in tissue. For purposes of calculation, tissue has been assumed to have the molecular formula  $(1) \text{C}_0.5\text{H}_8\text{O}_3.8\text{N}_{0.14}$ , and to be of unit density, *i.e.*, 15 per cent protein and 85 per cent water. The calculations can be easily extended to other materials and densities.<sup>2</sup> The accuracy is perhaps 5 per cent. However, exact values for various tissues can be quickly measured as soon as the fast protons are available.

Figure 1 shows, for example, that if we want to expose a region located 10 cm be-

<sup>1</sup> Accepted for publication in July 1946.

<sup>2</sup> The range of a proton in air in meters is given by the convenient formula  $R = (E/9.29)^{1.8}$  where the energy is expressed in Mev. The range in tissue is  $1.11 \times 10^{-3}$  times the range in air. The stopping power of other substances may be found in Livingston and Bethe, *Rev. Mod. Physics* 9, 246, 1937. The physical calculations of this paper will be submitted to the *Physical Review* for publication.

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millionths of an erg, each proton loses 48 millionths of an erg in the last centimeter. Hence, to produce 1 red averaged over the last centimeter of depth requires  $83/48 \times 10^6 = 1.72$  million protons per square centimeter. To produce 1,000 red will require 1.72 billion protons per square centimeter. This corresponds to a current of  $2.75 \times 10^{-10}$  amp/cm<sup>2</sup> of protons for a one-second exposure or  $4.6 \times$

mic and consider secondary effects. First, the energy loss of the proton is a statistical effect due essentially to the production of ions along its path, hence, not all protons of the same energy will stop at the same distance beneath the skin. This effect is called range straggling and is easy to calculate. The results of such calculations can be summarized by saying that the longitudinal width in which most protons

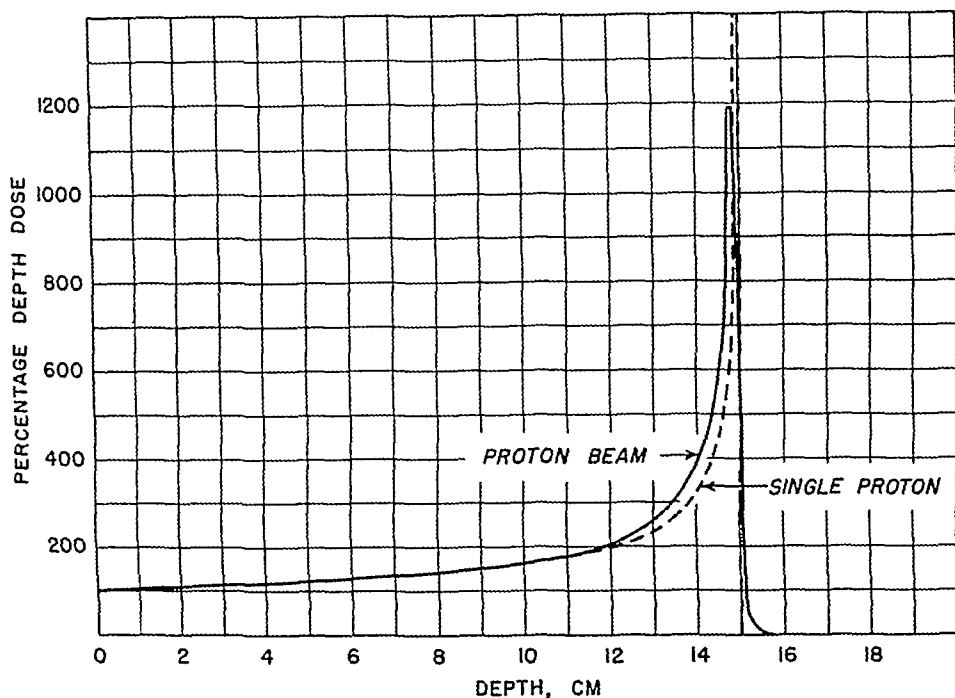


Fig 2 The dotted curve shows the relative dose due to a single 140 Mev proton. The full curve shows qualitatively the depth dose curve for a beam of 140 Mev protons in tissue.

$10^{-13}$  amp/cm<sup>2</sup> for a ten-minute exposure.<sup>3</sup> The machines now under construction should have little difficulty in producing such currents. In fact, it is expected that they will yield currents millions of times as great. It will be simple to collimate proton beams to less than 10 mm diameter or to expand them to cover any area uniformly. Let us now become a little more tech-

<sup>3</sup> More generally the red at a point  $x$  cm below the surface is given approximately by the formula

$$\text{red} = 4.8 \times 10^{10} \frac{j t}{(R - x)^2}$$

where  $R$  is the total range of the proton in tissue in cm,  $j$  the current density or protons in amperes/cm<sup>2</sup>, and  $t$  the exposure time in seconds. The formula is not accurate in the last millimeters of range.

come to rest is about 1 per cent of the initial range.<sup>4</sup> The effect of this on the depth dose curve is qualitatively shown in Figure 2. As a result of straggling, the full curve obtains instead of the dotted one.

A second effect is due to the many small

<sup>4</sup> The protons come to rest so that the distribution of their end-points is given by  $P(x)dx = \frac{R}{\alpha\sqrt{\pi}} e^{-\frac{(R-x)^2}{R^2\alpha^2}} dx$ , where  $x$  is the distance below the surface, and  $\alpha$  is given by

$$\alpha = \frac{7.1}{E_0^{1/2}} \left( \frac{NZ^2R}{E_0} \right)^{-0.033}$$

where  $N$  is the atoms per cm<sup>3</sup>,  $Z$  is the atomic number,  $z$  is the ion charge number,  $E_0$  is the rest energy of the ion in Mev, and  $R$  is the range in cm.

low the nearest surface, it will be necessary to have protons of 115 Mev. If a depth of 15 cm were required, then 140 Mev protons would be needed. The specific ionization curve needs a little interpretation. If we interpret the abscissae as the residual range, then there should be little difficulty in visualizing the specific ionization at various depths within the body. As a particular example, let us consider 140

ionization over the last centimeter is about six times that at the surface. In the final half centimeter of a particular proton track, the average dose is sixteen times the skin dose. The full curve is perhaps more realistic, however, and it will be explained later.

It is well known (2) that the biological damage depends not only on the number of ions produced in a cell, but also upon the

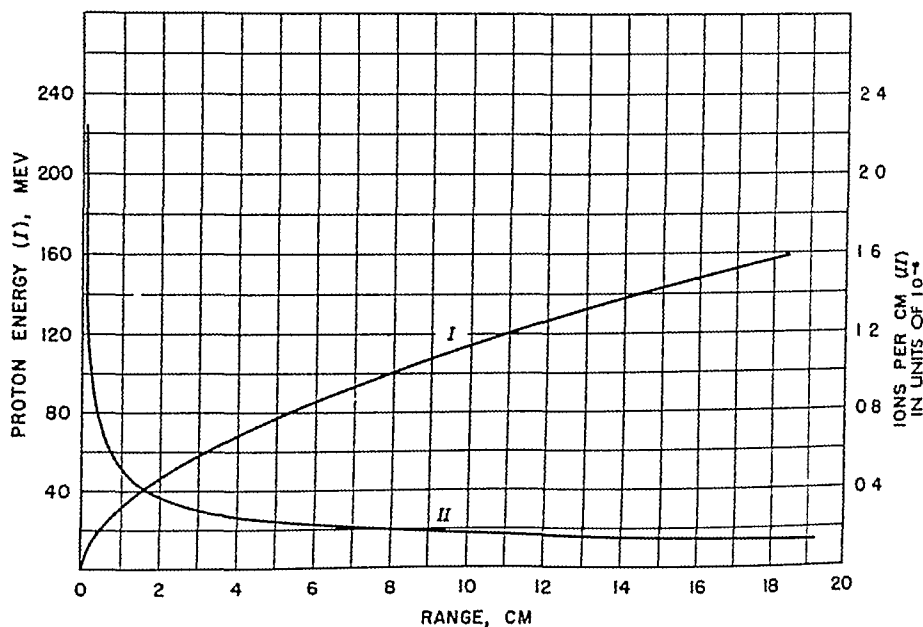


Fig 1 Curve I is the range-energy relation in tissue. Curve II shows the specific ionization as a function of the residual range of a proton in tissue.

Mev protons. In Figure 2, the dotted line is a depth-dose curve obtained by plotting the specific ionization taken from curve II of Figure 1 against the depth of proton in the tissue. Thus, at the surface, the residual range is 15 cm, and curve II of Figure 1 shows that the specific ionization for a proton of 15 cm range is 0.15 million ion pairs per centimeter. This point has been adjusted to 100 per cent in Figure 2. When the proton has proceeded into the tissue 7 cm, its residual range is 8 cm and the ionization of a proton of 8 cm range is 0.2 million ion pairs per centimeter or 133 per cent of the surface dose. The rest of the curve can be obtained in the same way, and we see that the curve rises sharply in the last few centimeters. The average

density of ionization. Thus the biological effects near the end of the range will be considerably enhanced due to greater specific ionization, the degree of enhancement depending critically upon the type of cell irradiated.

At this time we might inquire about the current of protons required for an irradiation. I shall use the roentgen equivalent dose, as it particularly is amenable to calculation for this application. One roentgen equivalent dose (r.e.d.) of protons will have been received at a certain point in the tissue when 83 ergs of energy have been absorbed per gram of tissue. In the last centimeter of range a proton loses 30.1 Mev (energy of a proton of 1.0 cm range, see curve I of Figure 1). Since 1 Mev is equal to 1.6



changed. Thus a 400 Mev alpha particle has a range of only 8 cm, but its specific ionization is  $0.8 \times 10^6$ , four times as great as for a proton of the same range. The intense specific ionization of alpha particles, when considered in the light of Zirkle's results, will probably make them the most desirable therapeutically when such large alpha particle energies are attained. For a given range, the straggling and the angular spread of alpha particles will be one-half as much as for protons. Heavier nuclei, such as very energetic carbon atoms, may eventually become therapeutically practical.

One naturally asks what are the advantages of fast protons over high-energy electrons such as those from a betatron (4). This question can be answered only by medical workers, and the answers will probably be different for different kinds and sizes of tumors. Certainly the differences between fast electrons and protons are only quantitative. The specific ionization for protons is much greater, and the concentration of ionization in a given volume is also greater because the straggling and spreading of electrons is worse. On the other hand, electrons of sufficient energy can be produced by more modest equipment.

Finally, I would like to emphasize the danger which will be lurking near the proposed high-energy machines. We have seen that a current density of a few times  $10^{-10}$  amp/cm<sup>2</sup> for one second could have lethal effects. The particles can penetrate the metal walls of the machines, and if less than one billionth of the proposed currents of about one microampere is scattered in the wrong direction, then workers may be in danger. This becomes particularly apparent when one considers that the range in air of a 150 Mev proton is about 150 meters. On the other hand, the range of such a proton in lead is only a few inches, and with thoughtful precaution accidents can be averted.

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angle scatterings of the proton as it passes the nuclei of the atoms of the tissue. This is called multiple scattering, and its effect is to spread the end of the beam out transversely. It is also easy to calculate, and it turns out that the transverse width which an infinitely narrow starting beam would have at the end of its range is about 5 per cent of the initial range.<sup>5</sup> Both effects are small, but they do indicate the limitations of precision available.

A third effect is that due to the nuclear absorption and scattering of the protons. The exact behavior of protons in nuclear reactions at such high energies as considered here must be determined by experiments to be carried out in the future. Present experiments using high-energy neutrons give good estimates of the radii of most nuclei (3). Probably whenever a fast proton hits the nucleus it will be captured and its energy will appear in several slower protons, alpha particles, or neutrons. In any case, the probability of a proton impinging on a nucleus after traveling 10 cm in tissue will be about 25 per cent. The effect tends to decrease the specific ionization at the end of the range by 15 to 30 per cent. Inasmuch as the specific ionization is several times greater at the end of the range than it is at the beginning, this will not be serious.

A similar effect is that due to elastic scattering of the protons by nuclei. The probability of this type of scattering is essentially the same as that of absorption. In this case, however, the proton is not stopped but continues at the same energy but in a different direction. The effect, then, is to diffuse about 20 to 40 per cent of the beam. For fairly broad beams this

<sup>5</sup> The transverse distribution of the end-points of the protons is given by

$$P(y)dy = \frac{R}{\beta\sqrt{\pi}} e^{-\frac{y^2}{\beta^2}} dy$$

where  $y$  is the distance from the average end of the range measured perpendicular to the initial direction of the beam and  $\beta$  is given by

$$\beta = 12 \left( \frac{Z}{E_0} \right)^{1/2} \left( \frac{NRZ^2}{E_0} \right)^{-0.88}$$

The numerical constant should be determined more accurately by experiment.

would not be noticeable because such scattering will be predominantly forward.

The above should be the principal effects, and we see that our original picture of a proton beam proceeding without spreading until it is stopped at high specific ionization in the tissue is only slightly modified. It will be possible to treat a volume as small as 10 cc anywhere in the body and to give that volume several times the dose of any of the neighboring tissue. The exact behavior of protons of the energy considered here will become known only when such protons are available for experiment.

In treating large tumors, for example, one will want to cover the whole volume with the very high ionization density which obtains over the last few millimeters. This can easily be accomplished by interposing a rotating wheel of variable thickness, corresponding to the tumor thickness, between the source and the patient.

The exposure can be monitored precisely simply by placing a shallow ionization chamber between source and patient. Absolute determinations of the dosage can be determined by measuring ionization currents in gases of the elements of tissue or in a gas which mocks up the molecular formula of tissue. What makes the problem of dosage measurement so simple is the absence of the wall effects encountered in x-ray or neutron exposure measurements. This is because the high-energy proton produces its secondary electrons at such low energy that their range is essentially zero.

The above results are easily generalized to other particles. Range and specific ionization of deuterons or alpha particles can be determined from Figure 1 for protons. If the proton energy ordinates are multiplied by two, as well as the range, curve 1 then holds for deuterons. Thus a 200 Mev deuteron has 16 cm range. The specific ionization remains the same, however, and a deuteron of 16 cm range makes  $0.14 \times 10^6$  ion pairs per cm. For alpha particles both ordinates are multiplied by four, but the range is left un-

changed. Thus a 400 Mev alpha particle has a range of only 8 cm, but its specific ionization is  $0.8 \times 10^6$ , four times as great as for a proton of the same range. The intense specific ionization of alpha particles, when considered in the light of Zirkle's results, will probably make them the most desirable therapeutically when such large alpha particle energies are attained. For a given range, the straggling and the angular spread of alpha particles will be one-half as much as for protons. Heavier nuclei, such as very energetic carbon atoms, may eventually become therapeutically practical.

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# Measurement of Radioactive Phosphorus in Breast Tumors in Situ; a Possible Diagnostic Procedure

## Preliminary Report<sup>1</sup>

B V A. LOW-BEER, M.D., H. GLENN BELL, M.D., H. J. McCORKLE, M.D., and ROBERT S. STONE, M.D.  
with the assistance of

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RADIOACTIVE phosphorus administered orally or intravenously in the form of disodium hydrogen phosphate solution is assimilated by different tissues in varying degrees. The concentration in tissues at any given time after administration depends on the metabolic activity of constituent cells. In general, malignant growths have a higher metabolic rate than the tissues from which they originate, and regenerating tissues also show greater metabolic activity than normal tissues. In both types of growth, therefore, a greater amount of phosphorus is taken up for the new cells that are forming. The differential distribution can be determined quantitatively by measuring the radioactivity of ashed samples of the tissues by means of a beta-ray electroscope, an electrometer, or by a Geiger-Muller counter. Such a determination necessitates the removal of the tissues in part or in whole.

If a lesion is located in the skin or close beneath the skin, the beta rays emanating from the disintegrating phosphorus atoms localized in the lesion should penetrate the tissues and come through into the air in sufficient number to be readily detected by a Geiger-Muller counter placed on the skin. Marinelli (1), in 1942, reported measuring such rays with a Geiger-Müller counter on three patients, one with a melanoma and two with mycosis fungoides. One of the present writers (Low-Beer), using a similar method, found increased activity not only over such skin lesions as mycosis fungoides, squamous-cell and ulcerating basal-cell carcinomata, psoriasis, eczema, and cutaneous Hodgkin's disease, but also over

subcutaneous lesions, such as lymphosarcoma in lymph nodes, cervical node metastases from transitional-cell carcinoma of the nasopharynx, bone metastases in the skull from carcinoma of the lungs, and others.

These findings suggested the investigation of the uptake of radioactive phosphorus in human breast tumors in order to determine, first, whether the differential concentration of phosphorus in such tumors could be detected by surface measurements, and second, whether or not it would be feasible to distinguish preoperatively between benign and malignant breast tumors by such surface measurements. It was thought that the same method might indicate the presence or absence of metastatic lesions in the axilla or supraclavicular area. To determine these points we studied patients with breast tumors prior to surgery. The measurements were made with bell-jar type Geiger-Muller counters with thin glass windows having a diameter of 1.5 to 2.5 cm.

Each patient was given from 300 to 500 microcuries of radioactive phosphorus intravenously in the form of isotonic disodium hydrogen phosphate solution, twenty-four or forty-eight hours before operation. Two, four, six, and twenty-four hours following injection, surface measurements were made directly over the palpable breast tumor and over comparable areas on the opposite normal breast and other fleshy parts of the body. After surgical removal, samples of the tumor, skin, fat, normal breast tissue, and muscle were dissected, weighed, and ashed. The radio-

<sup>1</sup> From the Divisions of Radiology and Surgery of the University of California Hospital, San Francisco, Calif.

activity of the ashed samples was determined quantitatively

To date 25 patients have been so studied. Five of these had lesions that were obviously malignant at the time of clinical examinations, and this was confirmed in the laboratory. In all 5 patients the counts over the palpable tumor were higher by at least 25 per cent than in corresponding areas of the opposite breast and adjacent areas of the same breast.

Twenty patients had palpable tumors in which the question of malignancy could not be resolved clinically. Eleven of these patients showed at least 25 per cent higher counts over the tumor area than over other areas in the same breast or corresponding areas of the opposite breast. All of these 11 patients were later proved by microscopic examination to have malignant tumors. Nine patients showed less than 25 per cent difference in counts between the involved areas and adjacent areas in the same breast and corresponding areas on the opposite breast. Of these 9, 8 were found by microscopic examination to have benign tumors. One of the group was shown by microscopic examination to have a malignant tumor. It was, however, a mucoid carcinoma with relatively few cells.

Postoperatively, quantitative determinations of the radioactivity of the removed tissues showed a five to ten times greater uptake of radioactive phosphorus in the cancer tissue than in any of the other tissue examined. The mucoid cancer was the only exception, its radioactive phosphorus

content being the same as that of the normal breast tissue. In the tumors shown to be non-malignant, the differential uptake of radioactive phosphorus demonstrated by the assay method never exceeded twice that in normal breast tissue.

The findings to date indicate that breast cancers can probably be diagnosed by this method, except for such slow-growing ones as mucoid carcinoma and, we expect, very deep-seated ones. The results appear to be sufficiently suggestive to justify further investigation. Until such time as this method of diagnosis may be established on a broader statistical line, it is suggested that a decision for or against the use of surgery in doubtful cases of malignancy of breast tumors should not be influenced by these findings.

It must be emphasized that this study is concerned solely with the *diagnosis* of carcinoma of the breast. The amount of radioactive material used would not "treat" the lesion at all.

Similar procedures are being used in an attempt to determine whether palpable axillary and supraclavicular nodes contain metastases or whether non-palpable metastases are present, but the results to date do not justify publication.

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# A Clinical Study of Normal and Pathologic Motor Activity of the Gallbladder

## Preliminary Report<sup>1</sup>

DAVID S. DANN, M.D., and ROBT. KORITSCHNER, M.D.

Kansas City, Mo.

FROM TIME TO time we have observed that patients were subjected to cholecystectomy merely because they presented right upper abdominal complaints and roentgen evidence of delayed emptying of the gallbladder (so-called poorly functioning gallbladder without stones), though general examination revealed no demonstrable cause for their symptoms. In most instances, the symptoms were unrelieved and histologically the gallbladders proved to be normal. This condition prevails despite the fact that many observers, as Graham and Mackey (1), Ivy and Bergh (2), Ravdin, Riegel, Johnston, and Morrison (3), Sosman (4), and others, have emphasized the differential diagnosis between the surgical and the non-surgical gallbladder. While lack of this knowledge may be one of the factors accounting for such errors in surgical judgment, another more important cause is the lack of completely established concepts concerning the normal physiology of the biliary tract.

With these considerations in mind, we decided to direct our investigation to one phase of biliary tract physiology, namely, the motor activity of the gallbladder.<sup>2</sup> Since we employed the x-ray method for this study, our interest was mainly centered on the mechanism of emptying of the gallbladder.

Before continuing with this discussion, it is necessary to clarify our conception of the term stasis, since it is generally associated with any consideration of this subject. To avoid any misconceptions, from the roentgen standpoint, we understand stasis to mean simply delayed emptying of the

gallbladder. Further, for the time being, we are not concerned with the maze of theories (6, 7, 8a, 9) anatomic and physiologic, which have been offered in an attempt to explain the cause of delayed emptying, but merely with its actual demonstration.

In studying the literature, one finds reports of experiments and observations on animals which have been subjected to various operative procedures (5, 10). Unquestionably, these procedures alter the normal functions of the gallbladder. Furthermore, in view of the fact that animals do not present the same conditions as man, either as to the anatomy and physiology of the gallbladder or the chemistry of the bile, the direct clinical application of such observations is a fallacy.

Graham and Cole's important discovery of visualization of the gallbladder (11) lends itself ideally to an investigation of this subject in man. Their method has been thoroughly studied by Boyden (8b), who employed a specific meal (five egg yolks, well mixed with a half a pint of cream) to determine the emptying time of the gallbladder. This highly concentrated fatty meal has been utilized by many investigators to study motility of the gallbladder and has been generally adopted as a routine procedure. In addition, other investigators (12, 13) have reported on delayed gallbladder emptying following starvation and high carbohydrate diets. All of these methods, while of great scientific interest, fail to conform with the normal daily routine dietary habits of the individual.

We have therefore decided to reopen the

<sup>1</sup> From the Departments of Radiology and Pathology, Menorah Hospital, Kansas City, Mo. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

<sup>2</sup> According to Ivy (5), the physiology of the gallbladder is manifested in three types of activity: absorption, secretion, and motor activity.

subject and study the motility of the gallbladder by a method which is in conformity with normal eating habits<sup>3</sup> This new approach may give additional information concerning the motor activity of the gallbladder under normal and pathologic conditions It may seem trite to state that basic knowledge of the normal must be established before determining the pathologic, but, in retrospect, we fear this process has been reversed in roentgen observations of the gallbladder

Our method of study to determine the normal is as follows (1) From the outpatient clinics, individuals of different ages, sex, and nationality are selected, with no history, past or present, of abdominal complaints (2) On the day preceding the roentgen examination, the patient is instructed to abstain from all fatty foods at lunch (3) At 4 P M, 3.6 gm of sodium tetraiodophenolphthalein<sup>4</sup> is taken in water or grape juice, and this dose is repeated at 6 P M if the subject is overweight This dye is employed because our past experience is mainly based on its use and most of the physiologic experiments have been performed with it No food is eaten until the x-ray examination the following morning at 8 o'clock (4) The patient is then instructed to eat his usual breakfast and, one hour later, x-ray studies are again made (5) Further roentgen studies are made one hour after each subsequent routine meal until the dye disappears In the meantime, the patient pursues his daily routine

The findings according to this method are recorded in the accompanying table

Before discussing the data in the table and our plan of further investigation, we wish to state that we are fully aware that definite conclusions cannot be drawn from this small series of observations The great shortage of films during the past war years has been a serious handicap and is mainly responsible for this shortcoming Certain trends, however, seem apparent

<sup>3</sup> In future studies, in addition to recording the contents of the meal, we intend to express the amount of fat consumed by actual figures

<sup>4</sup> We intend to conduct a comparative series of studies using Priodan

There is a wide range of normal emptying rate within the first twenty-four hours, having no definite relation to age, sex, or eating habits In only one case, Case 11, were forty-eight hours required for complete emptying of the gallbladder, even though meals ample in fat were consumed In contrast, a sixty-six-year-old man, Case 9, showed complete emptying after a breakfast which contained practically no fat Two patients, Cases 8 and 12, showed no contraction of the gallbladder after a breakfast containing an appreciable amount of fat, but emptying occurred after subsequent meals variable in fat A similar response was noted in Case 4, where meals of moderate fat content were consumed

These facts, meager as they are, suggest future trends of our investigation Normal subjects showing poor contraction after their routine meals will be further investigated with the Boyden meal It is possible that a person may show good emptying with the Boyden meal, yet may reveal marked delay under his normal eating habits On the other hand, there may be delayed response after the Boyden meal in someone who is accustomed to consuming large quantities of fat In other words, we are bent on determining whether the response to the Boyden meal is a true test of the emptying time of the gallbladder for a particular individual

Further, it is essential to determine the degree of variability of the individual emptying rate under normal conditions Returning to Case 11, in which forty-eight hours were required to empty the gallbladder completely, we must consider that this patient presented no abdominal complaint In this respect, she was as normal as those with complete emptying within the first twenty-four hours And it may very well be that in our future studies, comprising a large series, we will find individuals who require more than forty-eight hours for emptying of the gallbladders, but who still may be perfectly normal If this be the case, then we must revise our ideas concerning delayed emptying of the gallbladder (so-called poorly

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8	B B 1 11 5'2 1/2" 150 lb	Medium	2 fried eggs 2 slices bread, no butter, 1 tomato	No contraction	1 frankfurter, 2 glasses butter- milk, 1 bottle coca cola	Empty			
9	T B M 66 5'0 1/2" 133 lb	Good	Sliced oranges, dry toast, cup cake, 1 cup coffee with cream	Empty					
10	B H F 33 5'1" 131 lb	Good	1 scrambled egg, buttered toast, coffee	85	1 ham salad sand- wich, coffee, po- tato salad, coca cola	Empty			
11	H H F 54 5'4" 151 lb	Good	2 scrambled eggs, 1 piece buttered toast, 1 cup coffee	50	1 ham salad sand- wich, combina- tion salad, 2 cups coffee	75	Chicken steak, buttered car- rots, 2 slices bread with but- ter, 1 glass grapejuice	Still faintly outlined	2 pieces but- tered toast, 1 cup coffee
12	I W F 31 4'11" 109 lb	Good	2 scrambled eggs, 2 pieces buttered toast, 1 cup cof- fee with cream	No contrac- tion	2 sausages, 2 fried eggs, fried po- tatoes, 1 slice bread, 1 glass buttermilk, 1 coca cola	25	2 fried eggs, 2 slices bacon, 2 pieces bread, 1 tomato, 1 plum, 2 glasses water	Empty	
13	J M I 20 5'1" 120 lb	Good	1 scrambled egg, 2 pieces toast, 1 glass milk, 1 cup coffee with cream	No record					
14	C S M 57 5'0" 172 lb	Fair	2 scrambled eggs, buttered toast, 1 glass milk	25	Roast beef, corn, potatoes	Empty			
15	W K M 25 5'10" 144 lb	Good	Scrambled eggs, toast, coffee	75	Oatmeal, milk	Empty			
16	L G I 35 5'2" 127 lb	Good	2 strips bacon, 2 eggs, 1/2 grape- fruit, 2 slices rais- in bread toast, butter, jelly, 1 cup black coffee	25	Grilled cheese sandwich, small coca cola, ice cream	50	4 rich cookies, 2 cups tea, 1/2 slice bread, 2 pats butter, 1 cup ice cream	80	Oatmeal with milk, 2 slices whole wheat bread with butter and jelly, orange, 1 cup coffee with milk

\* Approximately one hour after lunch (steak, corn on cob with butter, 1 slice of bread and butter) emptying was complete

Table cont on p 409)

TABLE 1 RATE OF GALLBLADDER EMPTYING IN NORMAL SUBJECTS FOLLOWING THEIR USUAL ROUTINE MEALS

Subject Sex Age Height Weight	Concentration 15 Hours After In- gestion of Dye	Breakfast	Approximate Contraction 1 Hour After Breakfast, %	Lunch	Approximate Contraction 1 Hour After Lunch, %	Dinner	Approximate Contraction 1 Hour After Dinner, %	Breakfast	Approximate Contraction 1 Hour After Breakfast, %
1 E H F 55 5' 2" 92 lb	Good	1 piece buttered toast, 2 scrambled eggs, 1 cup black coffee	50	1 ham salad sand wich, 1 cup coffee with cream, apple	75	Macaroni cheese, bread pudding, lemon- ade	Empty		
2 E W F 59 5' 4" 221 lb	Good	6 crackers, 2 cups coffee with cream	50	Boiled cabbage, boiled beef, lunch meat, sliced tomatoes, 1 cup coffee with cream	75	Fried corn, sliced tomatoes, lima beans, bacon, bread and but- ter, coffee	95		
3 C H M 41 5' 9" 128 lb	Fair	Cream of wheat with milk, 1 slice bread and but- ter, 1 cup coffee with milk	60	2 frankfurters, spinach with butter, 2 slices bread and but- ter, iced tea, canned peaches	75	Steak, boiled po- tatoes, gravy, buttered peas, 2 slices bread and butter, cinna- mon roll, 1 glass milk	Empty		
4 L S F 70 5' 3" 188 lb	Good	2 slices buttered toast with jelly	No contrac- tion	1 hamburger patty, 2 slices bread and butter, 1 cup coffee with cream	Empty				
5 R. J M 24 6' 1" 210 lb	Good	Wheaties with cream, 2 soft- boiled eggs, 2 pieces toast with oleo, 1 glass milk, 2 glasses water, 1/2 cantaloupe	90	2 pork chops, mashed pota- toes, 1 slice bread and oleo, 2 glasses milk	Empty				
6 C deL F 14 5' 3" 109 lb	Good	2 slices buttered toast, 1/2 scram- bled egg, 1 glass milk, 1 cup coffee with cream	75	1 frankfurter, 2 glasses malted milk, nut and chocolate candy bar, ice cream cone	Empty				
7 T deL F 16 5' 2" 109 lb	Good	2 slices buttered toast, 1/2 scram- bled egg, 1 glass milk, 1 cup coffee with cream	75	1 frankfurter, 2 glasses malted milk, nut and chocolate candy bar, ice cream cone	Empty				

		Medium	2 fried eggs, 2 slices bread, no butter, 1 tomato	No contraction	1 frankfurter, 2 glasses butter-milk, 1 bottle coca cola	Empty	Chicken steak, buttered carrots, 2 slices bread with butter, 1 glass grapejuice	Still faintly outlined	Still faintly outlined*
8	B B 1 11 5' 2 1/2 150 lb								
9	T B M 66 5' 9 1/2 133 lb	Good	Sliced oranges, dry toast, cup cake, 1 cup coffee with cream	Empty	1 ham salad sandwich, coffee, potato salad, coca cola	Empty			
10	B H F 43 5' 1 131 lb	Good	1 scrambled egg, buttered toast, coffee	85					
11	H H F 54 5' 4 151 lb	Good	2 scrambled eggs, 1 piece buttered toast, 1 cup coffee	50	1 ham salad sandwich, combination salad, 2 cups coffee	75	2 fried eggs, 2 slices bacon, 2 pieces bread, 1 tomato, 1 plum, 2 glasses water	Empty	2 pieces buttered toast, 1 cup coffee
12	I W F 31 4' 11 109 lb	Good	2 scrambled eggs, 2 pieces buttered toast, 1 cup coffee with cream	No contraction	2 sausages, 2 fried eggs, fried potatoes, 1 slice bread, 1 glass buttermilk, 1 coca cola	25			
13	J M F 29 5' 1 120 lb	Good	1 scrambled egg, 2 pieces toast, 1 glass milk, 1 cup coffee with cream	No record	Roast beef, corn, potatoes	Empty			
14	C S M 57 5' 9 172 lb	Fair	2 scrambled eggs, buttered toast, 1 glass milk	25	Oatmeal, milk	Empty			
15	W K M 25 5' 10 144 lb	Good	Scrambled eggs, toast, coffee	75					
16	L G F 35 5' 2 127 lb	Good	2 strips bacon, 2 eggs, 1/4 grapefruit, 2 slices raisin bread toast, butter, jelly, 1 cup black coffee	25	Grilled cheese sandwich, small coca cola, ice cream	50	4 rich cookies, 2 cups tea, 1/2 slice bread, 2 pats butter, 1 cup ice cream	80	Oatmeal with milk, 2 slices whole wheat bread with butter and jelly, orange, 1 cup coffee with milk

\* Approximately one hour after lunch (steak, corn on cob with butter, 1 slice of bread and butter) emptying was complete

Table cont on p 499

TABLE I RATE OF GALLBLADDER EMPTYING IN NORMAL SUBJECTS FOLLOWING THEIR USUAL ROUTINE MEALS (Continued)

Subject Sex Age Height Weight	Con- traction 15 Hours After In- gestion of Dye	Breakfast	Approximate Con- traction 1 Hour After Breakfast, %	Lunch	Approximate Con- traction 1 Hour After Lunch, %	Dinner	Approximate Contraction 1 Hour After Dinner, %	Breakfast	Approximate Con- traction 1 Hour After Breakfast, %
17 P S F 30 6' 3 1/4" 180 lb	Good	1 egg, 2 strips ba- con, 1 slice but- tered toast, jelly, 1 cup coffee, 1 teaspoon cream	50	1/2 cup cottage cheese, 1 small raw carrot, 1 slice bread, 1 teaspoon butter, 1 cup coffee, 1 teaspoon cream	80	1/2 lunch ham sandwich, 1 scant cup potato chips	No change	1 piece but- tered toast, 1 cup black coffee	Empty
18 H M F 40 5' 3" 113 1/2 lb	Good	2 strips bacon, 2 eggs, 2 slices ra- isn bread toast, butter and jelly, 1/2 grapefruit, 1 cup black coffee	50	1 grilled cheese sandwich, 1 cup coffee	75	5 rich cookies, 1 1/2 cup tea, 1/2 slice bread, 1 pat but- ter, 1/2 cup cream	Empty		
19 B N F 41 5' 3" 105 lb	Good	2 pieces toast, 1 cup black coffee, 1 glass orange juice	Practically no con- traction	Combination salad, baked trout, mashed potatoes and gravy, corn bread, peach pie, 1 cup black coffee	25	1 boiled frankfur- ter, fried potato cake, 1 cup green beans, 2 small pieces cel- ery, sliced peaches, 1 slice bread, 1 cup tea, cookie	50	1 piece toast, small glass pineapple juice, 1 cup black coffee	Empty
20 M S † F 36 5' 1" 136 lb	Practically no concentration on repeated dye								
21 B C † M 27 5' 9" 228 lb	Practically no concentration on repeated dye								

† The failure of visualization of the gallbladder may be due to premature contractions, according to Boyden (8c)

functioning gallbladder) and stasis. May not our present concept of stasis of the gallbladder be subject to the same errors as our concept of stasis of the colon entertained in a bygone era? It will be recalled, as Barclay (14) points out, that "it was thought that in the alimentary tract, movements took place on a fixed schedule—if this schedule was not adhered to, stasis occurred in various parts, toxic products were absorbed, and symptoms would result. The diagnosis of stasis was invoked for seemingly any and every disease. Stasis-minded surgeons were prone to perform the slinging-up operations on the caecum." Are we passing through a similar phase in relation to the gallbladder?

Our future studies will be directed toward answering these questions and determining the validity of the above concepts. Finally, our efforts will be directed toward taking the problem of delayed emptying of the gallbladder out of the realm of empirical speculation and placing it on a scientific basis.

#### SUMMARY

1 A preliminary report is made on a study of one phase of biliary tract physiology—the motor activity of the gallbladder. Since the x-ray method is used, interest is mainly centered on the mechanism of emptying.

2 To determine the normal emptying time of the gallbladder, a method is employed which conforms with the normal eating habits of the individual.

3 Present and future trends of this investigation are discussed.

4 A concept concerning delayed emptying of the gallbladder (so-called poorly functioning gallbladder), or stasis, is presented.

NOTE We wish to thank Mrs Mildred Kice and Miss Helen Root for aid in preparation of the manuscript.

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TABLE I RATE OF GALLBLADDER EMPTYING IN NORMAL SUBJECTS FOLLOWING THEIR USUAL ROUTINE MEALS (Continued)

Subject Sex Age Height Weight	Concentration 15 Hours After In- gestion of Dye	Breakfast	Approximate Con- traction 1 Hour After Breakfast, %	Lunch	Approximate Con- traction 1 Hour After Lunch, %	Dinner	Approximate Contraction 1 Hour After Dinner, %	Breakfast	Approximate Con- traction 1 Hour After Breakfast, %
17 P S F 30 6' 3 1/4" 180 lb	Good	1 egg, 2 strips bacon, 1 slice buttered toast, jelly, 1 cup coffee, 1 teaspoon cream	50	1/2 cup cottage cheese, 1 small raw carrot, 1 slice bread, 1 teaspoon butter, 1 cup coffee, 1 teaspoon cream	80	1/2 lunch ham sandwich, 1 scant cup potato chips	No change	1 piece buttered toast, 1 cup black coffee	Empty
18 H M F 40 5' 3" 113 1/2 lb	Good	2 strips bacon, 2 eggs, 2 slices raisin bread toast, butter and jelly, 1/4 grapefruit, 1 cup black coffee	50	1 grilled cheese sandwich, 1 cup coffee	75	5 rich cookies, 1 1/2 cup tea, 1/2 slice bread, 1 pat butter, 1/2 cup cream	Empty		
19 B N F 41 5' 3" 105 lb	Good	2 pieces toast, 1 cup black coffee, 1 glass orange juice	Practically no contraction	Combination salad, baked trout, mashed potatoes and gravy, corn bread, peach pie, 1 cup black coffee	25	1 boiled frankfurter, fried potato cake, 1 cup green beans, 2 small pieces celery, sliced peaches, 1 slice bread, 1 cup tea, cookie	50	1 piece toast, small glass pineapple juice, 1 cup black coffee	Empty
20 M S † F 36 5' 1" 136 lb	Practically no concentration on repeated administration of dye								
21 B C † M 27 5' 9" 228 lb	Practically no concentration on repeated administration of dye								

† The failure of visualization of the gallbladder may be due to premature contractions, according to Boyden (8c)

sarcomas into several types, but for the present purpose it will suffice to follow Stout's suggestion that they be looked upon as a single group capable of manifesting different degrees of differentiation. He lists the following: (1) a well-differentiated myxoid type, (2) a poorly-differentiated myxoid type, (3) a round-cell or adenoid type, (4) a mixed group. It is questionable if cases of the first type ever metastasize, and by many authors they would not be accepted as sarcomas, the other types are definitely malignant.

Difference of opinion also prevails as regards the radiosensitivity of these tumors. Very few instances are recorded in which radiation in adequate dosage has been employed in their management, and brief and incomplete periods of follow-up examination detract considerably from the value of many of these accounts.

The case here reported was encountered in a series of more than 2,200 personally treated cancer patients. There is no other recorded instance of this disease in the pathological laboratories of the three general hospitals in the city of Windsor. The histologic diagnosis, made by Dr. S. M. Asselstine, has been confirmed by Professor James Miller of the Department of Pathology of Queen's University, Kingston, Dr. M. E. Maun of Wayne University Medical School, Detroit, and Dr. Arthur Purdy Stout of Columbia University, New York. Dr. Stout reported as follows: "I am in agreement with Dr. Asselstine that it is a liposarcoma. The tumor, both in its primary manifestation and in the lung metastasis, tends to form rounded cells, most of them with foamy cytoplasm, although some show no evidence of intracellular lipid. This is, then, one of the less common round-cell forms of liposarcoma, which reproduce in their growth the appearance of brown fat. It is interesting to find a tumor which maintains the same morphology everywhere and does not tend to reproduce the more common myxomatous form of embryonal fat." Five of the 41 cases reported by Stout were of this round-cell type. No follow-up records were

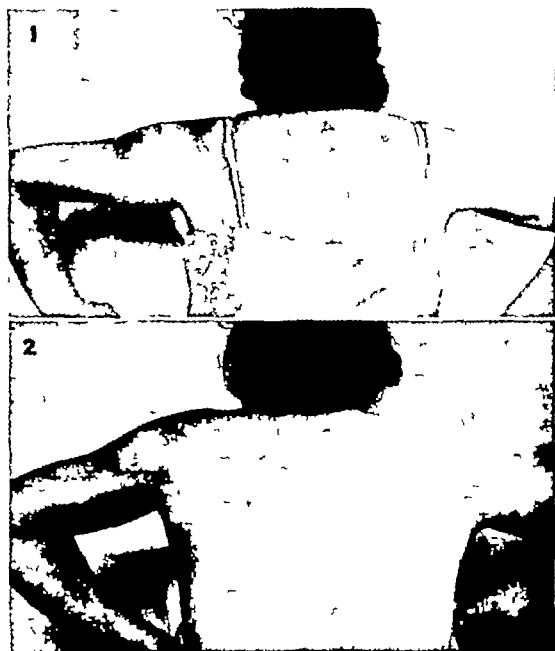


Fig. 1 Liposarcoma of soft tissues of the arm of a woman 29 years of age. There was a history of rapid growth following accidental discovery of the tumor six months previously.

Fig. 2 Appearance three months after surgical excision and interstitial radium treatment, and two months following completion of postoperative x-ray therapy.

available for 2 of his patients, 2 died in six and fifteen months, respectively, from pulmonary metastases, 1 is reported alive without recurrence after nine years. It would be difficult, if not impossible, to determine the number of cases of this type among the 134 other cases recorded in the literature, but it is evidently small. The rarity of the type, coupled with the fact that this patient was treated by both surgical and radiotherapeutic procedures, kept under observation six years and three months after she was originally seen, and then studied at autopsy, would appear to warrant the following report.

#### CASE REPORT

A white woman, aged 29 years, married and the mother of three children, was referred on Feb. 13, 1938, for consultation respecting a swelling in her left arm and a painful mass in the pelvis. She had first noticed the swelling in the arm six months previously, when it was the size of a hen's egg. She had been advised to apply hot fomentations, but these failed to have any effect on the swelling, which increased rapidly in size. Five weeks previous to

# Liposarcoma A Case Report<sup>1</sup>

NORMAN A. McCORMICK, M.B., F.A.C.R., F.R.C.S. (Edin.)

Windsor, Ontario

IT IS remarkable that a tissue so common as fat and so prone to benign tumor formation should so seldom be the source of cancer. Liposarcomas, while not often omitted from any classification of tumors, occur only rarely. Although the tumor was recognized histologically by Virchow in 1857, it is difficult, from available data, to estimate the number of cases reported. In a critical analysis of the literature in 1916, Robertson (10) accepted only 18 cases. Moreland and McNamara (8) comment upon the few recorded instances but suggest that these growths may have been mistaken for endotheliomas and other tumors. They describe 9 cases of liposarcoma in a group of 16,000 patients with tumors, and offer the opinion that the clinical frequency may be greater than the few reported histories would indicate. Mallory (7), on the other hand, says that the pathological diagnosis of liposarcoma is unusual, that the presence of fat in tumor cells is not particularly uncommon and may merely indicate a degenerative phenomenon, and that he is rarely confident in making a diagnosis of liposarcoma. Stout (13), recently reporting upon a series of patients with liposarcoma, has comprehensively reviewed the literature and histology of these growths and compiled an extensive bibliography. He states that 134 cases are recorded, and adds 41 more which have been studied in the Laboratory of Surgical Pathology of Columbia University during thirty-seven years (21 originating from the Presbyterian Hospital, the remainder from other sources).

In the Columbia University group, 35 per cent of the tumors arose from the thigh, popliteal space, and gluteal regions, 16 per cent occurred in the retroperitoneal, perirenal, omental, and mesenteric tissues,

6 cases involved the trunk, 5 the head, face, and neck, 3 the groin and inguinal canal, 3 the leg, 3 the arm and forearm, 1 the breast. This distribution corresponds to that found by Moreland and McNamara and other authors, who place the most frequent site of origin in the soft tissues of the lower extremities or retroperitoneal space. Cases are reported occurring in the vulva (14), bone (12), extradural space (3), mediastinum (9), pleural cavity (2), uterus (11), and stomach (1).

The tumor may appear in patients of any age, including children (6), but is most often seen in the years between thirty and sixty. Unlike lipomas, which are said to be three times more common in females than in males, liposarcomas have been recorded slightly more frequently in the male sex. Growth, frequently rapid, may be slow and symptomless over a period of many years. The tumor is characteristically encapsulated, and seemingly readily removable, but recurs, often repeatedly and in a more anaplastic state, ultimately to cause death by pulmonary metastasis.

The theory, held for many years, that fat cells are merely fibroblasts modified for the function of fat storage is no longer acceptable. Fat cells are now believed to originate from their own specialized lipoblasts, which are readily distinguishable from fibroblasts, especially, according to Stout, when grown *in vitro*. Abnormal tumor growth of these lipoblasts usually brings about the development of a lipoma, more rarely a liposarcoma. While the majority of liposarcomas originate as such, an undetermined but definitely small percentage result from malignant change in an already existing lipoma.

Considerable variation of opinion exists as to the advisability of subdividing lipo-

<sup>1</sup> From the Neoplastic Service, Metropolitan General Hospital, Windsor, Ont. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.



of gelatinous substance was escaping from a minute rupture of the capsule posteriorly. The capsule, bound down by delicate adhesions, was enucleated in an otherwise intact manner, and without difficulty, from all areas except the lateral head of the triceps, a portion of which muscle was removed along with the tumor. The excision appeared to surround the growth completely. Five 10-mg and three 5-mg radium element needles with 0.6 mm of platinum filtration were implanted in the long

sists of polyhedral cells with nuclei of various sizes, many of these cells are vacuolated, in some areas the cells are more spindle-shaped. A considerable fibrous stroma divides the cells into large groups. At one point there is definite invasion of the capsule, with growth extending into the surrounding muscle tissue. Some areas are fairly vascular, and there is some haemorrhage into the tissue. A few mitotic cells are present. Fat stain shows the vacuolated cells to contain fat" (Fig 3)



Fig 4 Photomicrograph of recurrent nodule from beneath the operative scar, three and one-half years after removal of primary tumor. In comparison with the original tumor, the recurrence contains more fairly large, polyhedral cells, with fewer vacuoles, and more numerous mitotic figures.

head and severed margin of the lateral head of the triceps, and the posterior border of the deltoid, for a dose of 1,825 mg/hr.

The pathological report was as follows:

**"Macroscopic"** The specimen consists of an encapsulated new growth  $10.5 \times 7.5 \times 4.5$  cm in size. The cut surface is soft and irregular, with an area showing considerable haemorrhage into the tissue.

**"Microscopic"** The majority of the growth con-

#### **"Pathological Diagnosis"** Liposarcoma

The wound healed normally, and a course of post-operative roentgen irradiation through four portals was begun on March 1, utilizing the same factors as before, for a total further dosage of 4,400 r, this was completed on March 30. On April 22, the patient had a well developed erythema, but no actual blistering; there had been a gain of 16 pounds in weight. On May 20, the skin was normal (Fig 2).

consultation, a severe pain in her abdomen caused her to faint. For two weeks she had had a high temperature, and for ten days there had been a purulent discharge from the rectum.

The mass in the left arm, situated immediately below the axilla, measured  $9 \times 9 \times 7$  cm. It seemingly was attached to the triceps muscle, was only slightly movable, and quite firm in consistency (Fig 1). It was not attached to either skin or bone. Pelvic examination revealed a large abscess, which

Roentgen irradiation of the tumor was advised as a preliminary to surgical removal, 200 r, measured in air, was given for each of 8 daily doses at 200 kv, 20 ma, and 50 cm S.T.D., through two  $10 \times 15$ -cm portals, with a Thoraeus "A" filter. No apparent change in the tumor resulted during this time, but there was a marked improvement in the pelvic condition, with subsidence of the temperature to normal and a blood count indicative only of secondary anemia.

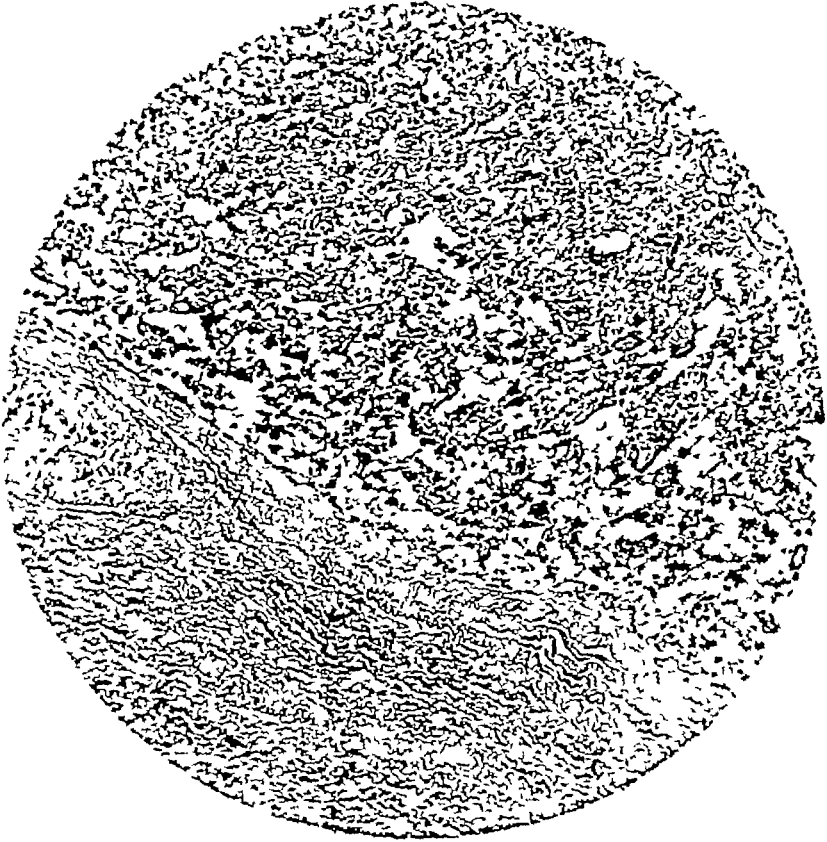


Fig 3 Photomicrograph of primary tumor. A fibrous stroma separates masses of rounded cells into large groups. Many of these cells are vacuolated, foamy, and contain fat. *Diagnosis:* Liposarcoma of round-cell or adenoid type.

was draining through the rectum. No other masses could be felt, and there was no lymphatic enlargement. The patient weighed 128 pounds, the loss from her usual weight of 175 pounds she attributed to dieting and to her recent pelvic trouble. X-ray examinations of the chest and left humerus were negative. The clinical impression was that the tumor was malignant, probably either a myosarcoma or a fibrosarcoma, and that the pelvic abscess was entirely coincidental.

Operation was performed on Feb. 21, 1938. A vertical incision some 20 cm in length was made over the posterior border of the deltoid. The deep fascia was opened, the deltoid was retracted forward, and the long head of the triceps posteriorly, exposing the brachial vessels and radial nerve. An encapsulated, soft, yellowish tumor was found lying beneath the deltoid and intimately attached to, and seemingly arising from, the lateral margin of the lateral head of the triceps. A small quantity

with fewer vacuoles and numerous mitotic figures (Fig 4.) *Diagnosis* Liposarcoma "

The wound healed slowly, a small necrotic area at its base persisting for several months, but without any evidence of further recurrence of the tumor, and the next summer the patient underwent an operation for the coexisting pelvic inflammatory disease.

The patient continued to report regularly for examination, and on Nov 5, 1943, a second recurrence

palpable. Although the patient's weight had been maintained at 140 pounds, she began to suffer considerably from pleuritic pain, and on Jan 15, 1944, the chest examination was repeated. The area previously noted was found to be more extensive and of greater density than on Nov 8, now reaching to the level of the 8th interspace (Fig 5, B). On March 9, 1944, 1,000 c c of clear yellowish fluid were withdrawn from the pleural cavity. A film now showed

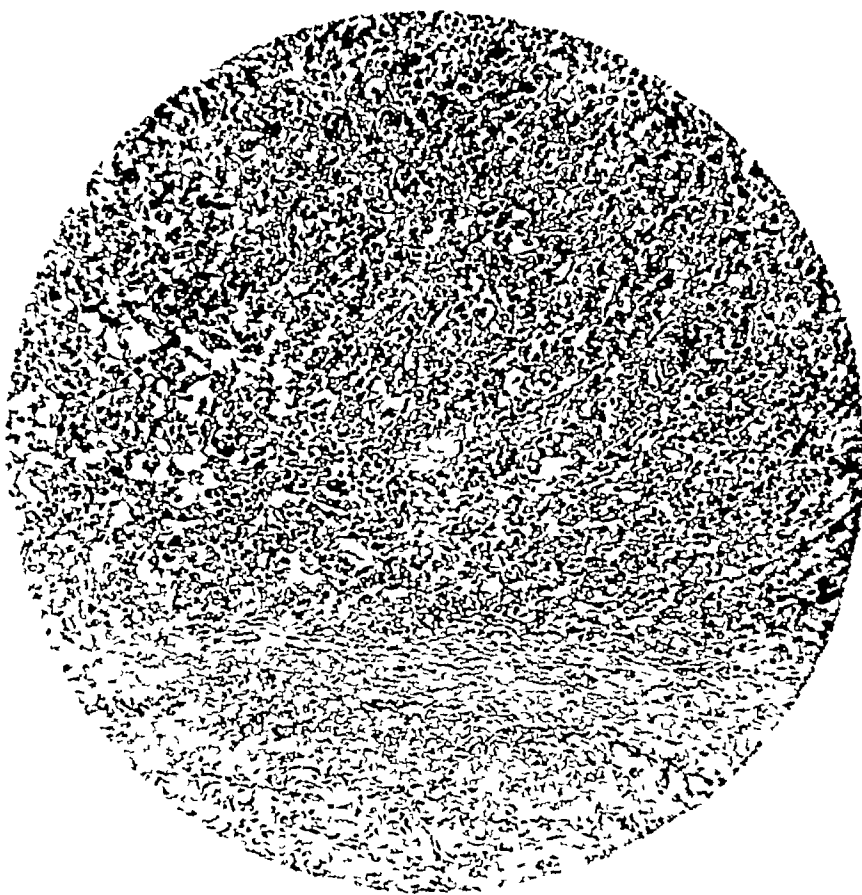


Fig 7 Photomicrograph of pulmonary metastasis. The morphology of the primary tumor is maintained, with no tendency to reproduce the more common myxomatous form of embryonal fat.

was observed, as a rounded, moderately firm mass,  $5 \times 1$  cm, in the substance of the triceps muscle, high up beneath the upper portion of the scar. A chest film at this time (Fig 5, A) showed a large area of consolidation above the left diaphragm, extending as high as the level of the 9th interspace posteriorly. An additional course of 200-kv therapy was given to the axillary region, centered over the tumor in the arm, 4,200 r being delivered to this area between Nov 8 and Dec 1, 1943. By Dec 16 the mass was very much smaller and barely

complete obliteration of the lower two-thirds of the left lung field with considerable fluid still present (Fig 5, C). Two days later another 700 c c. of fluid were withdrawn. Subsequent deterioration was rapid, and death occurred on May 25, 1944.

At autopsy several pints of straw-colored fluid were found in the left pleural cavity. An incompletely encapsulated tumor,  $28 \times 22 \times 15$  cm (Figs 6 and 7) occupied the lower lobe of the left lung and was adherent to the posterior pleural wall, the diaphragm, and the surface of the pericardium.



Fig 5 Roentgenograms of chest showing the rapid growth of the metastatic tumor A Nov 8, 1943 B Jan 15, 1944 C March 9, 1944, six years after removal of the original lesion in the arm

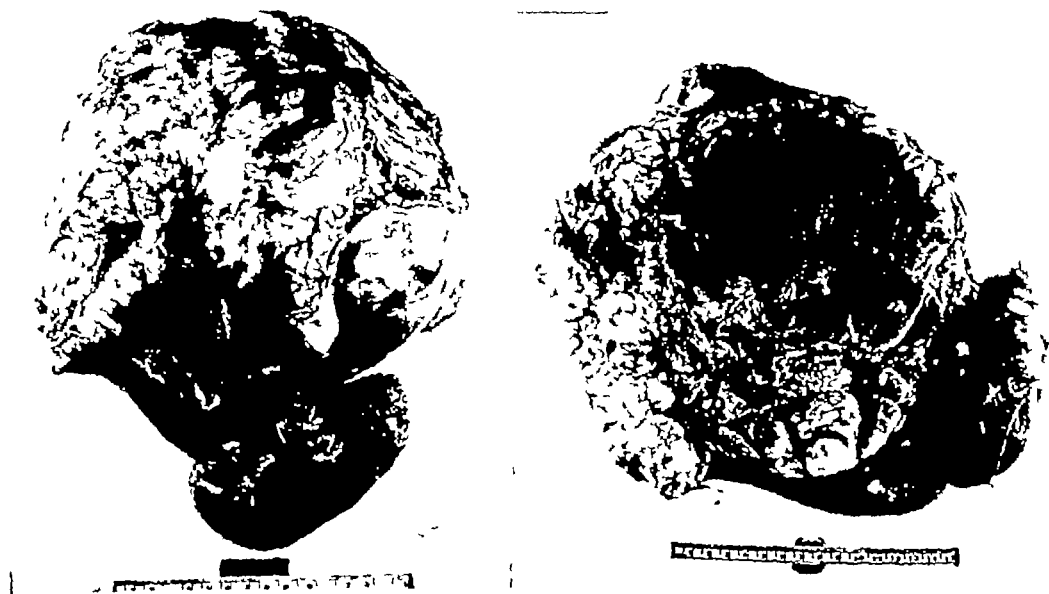


Fig 6 Incompletely encapsulated pulmonary metastasis six years and three months after first admission

Examination at regular intervals during the ensuing three years showed no evidence of the growth or change in weight, but on Aug 22, 1941, a nodule 13 mm. in diameter was found immediately beneath the skin, 1 cm. medial to and 3 cm. above the lower end of the operative scar. This was excised on the following day, through an elliptical incision 6 cm. in length and 3 cm. in width, with removal of the underlying superficial fascia and outermost fibers of the triceps muscle. The nodule was encapsulated and appeared to be entirely removed. Four 5-mg. radium element needles were inserted in the triceps muscle beneath the site of excision, and the wound

was closed with silk. The needles were left in place for 73 1/4 hours, giving a dose of 1,470 mg. hr.

The pathological report was as follows:

**Macroscopic** A diamond-shaped area of skin 4 cm. long and 2 cm. wide at the broadest portion, with an area of fatty and fibrous tissue  $5.0 \times 4.0 \times 1.5$  cm. in size. In the center of the latter is a small encapsulated area 1.5 cm. in diameter.

**Microscopic** The sections consist of a new growth of fairly large round cells, many of the foam-cell type. There is definite invasion of the muscle. In comparison with the original tumor, the recurrence contains more fairly large polyhedral cells

# Albers-Schonberg Disease—A Family Survey<sup>1</sup>

CHARLES H. KELLEY, M.D., and JOHN W. LAWLAH, M.D.

Washington, D. C.

**A**LBERS-SCHÖNBERG disease or "marble bones" is a disease of unknown etiology, familial in occurrence, and characterized by an increase in the radiographic density of the bones, but with preservation of their structural contour. The condition is usually widespread throughout

narrowed. This results in pressure on the cranial nerves, with such sequelae as facial palsy or paralysis, speech defects, deafness, optic atrophy, etc. The presence of some of these sequelae, namely, partial facial paralysis, bilateral impaired hearing, and a speech defect, along with intractable

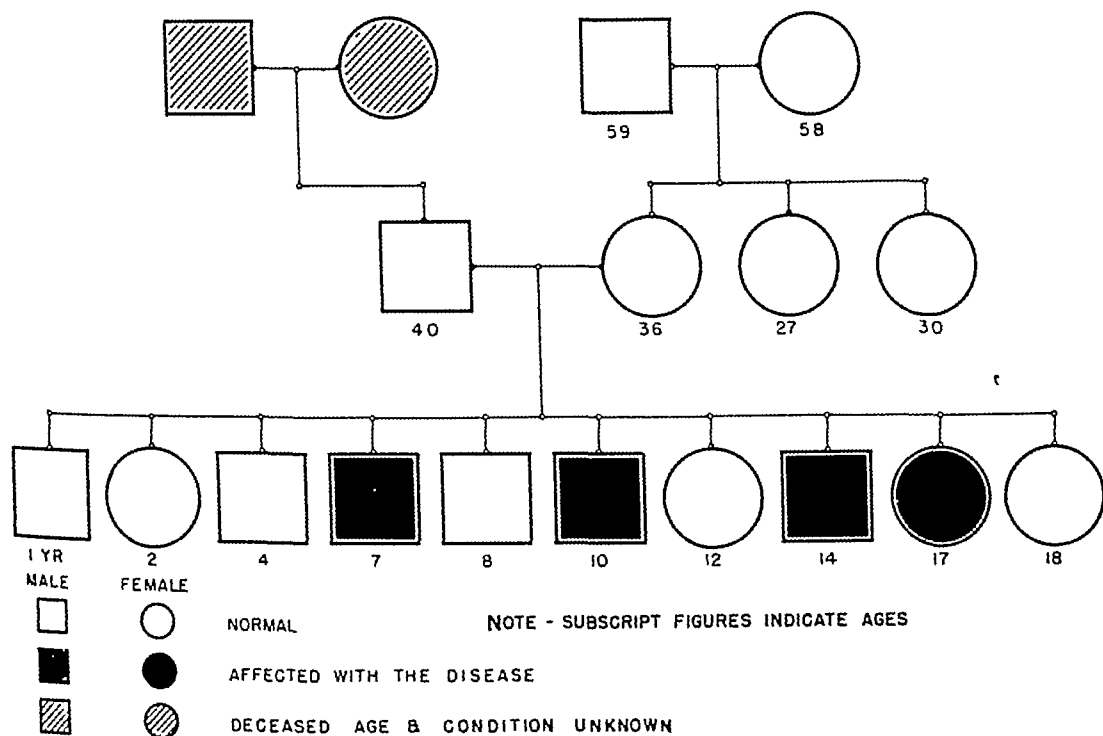


Chart I Incidence of Albers-Schonberg disease in three generations

the skeletal system. On roentgenograms the bones appear almost homogeneous in consistency, and differentiation between compact and cancellous bone is absent. Progressive anemia, which is characteristically seen in the disease, is probably explained by the destruction of the bone marrow by the lime deposits. The base of the skull is frequently involved, and the foramina of exit for the cranial nerves are

headache, was the clinical reason for the reference for roentgenograms of the skull of our first patient with Albers-Schonberg disease. After the disease was recognized in the first patient, roentgenograms of all members of the family were subsequently made, a procedure which should be followed wherever possible. This survey included all ten children of the family, the two parents, two sisters of the mother, and

<sup>1</sup> From the X-Ray Department of Freedman's Hospital and Howard University College of Medicine, Washington, D. C. Accepted for publication in December 1945.

The upper lobe was collapsed. The entire lung weighed 3,650 gm. There was no other demonstrable growth in the thoracic or abdominal cavities, and no gross evidence of tumor at the site of the last local recurrence under the operative scar on the arm, this area unfortunately, however, was not examined microscopically.

#### DISCUSSION

The encapsulation of these tumors is apt to delude one into proffering a good prognosis, whereas all authors agree that recurrence and ultimate metastasis are the rule, although in Geschickter's series (5) an average period of ten years elapsed between the first complaint and the occurrence of known metastases.

The location of the tumor in the case here reported was such that amputation was believed to offer little prospect of satisfactorily eliminating the disease, with the result that the patient was treated more or less in accordance with the recommendations of Ewing (4), who states that "the high mortality following surgical extirpation, together with the considerable radiosensitivity of many of the tumors, especially the myoliposarcomas, seems to call for a conservative program involving diagnosis by aspiration, external radiation, followed by interstitial radiation if required, and surgical resection of the residual tumor if demanded." While failure of the primary tumor to respond visibly to 1,600 r of roentgen radiation, in the case reported, is indicative of at least moderate radioresistance, 4,200 r caused regression in size and ultimate macroscopic disappearance of the final local recurrence. The fact that these local recurrences did, however, take place, despite initial heavy post-operative irradiation, makes it appear unlikely that cure can be obtained by such means. Amputation has seldom been resorted to in these cases, probably because the location of the tumor so often renders it impossible or, at the most, highly undesirable, but the bad end-results so far obtained would cause the author to recommend an adequate course of preoperative roentgen irradiation followed by amputation wherever possible.

#### SUMMARY

Liposarcomas are rare but on occasions add to the interesting diagnostic and therapeutic problems of a tumor clinic.

The tumor in the case reported is one of the less common round-cell forms, simulating brown fat, rather than the more commonly encountered myxomatous type which resembles embryonal fat.

The patient remained free from any evidence of her disease for three and one-half years following excision and radiotherapy and then had a recurrence in the lower end of the operative scar. This was satisfactorily obliterated, and she remained clinically free for a further period of two years, when another recurrence developed nearby, as well as metastasis to the lung, which caused death six years and three months after the original admission.

To date, local recurrences and ultimate death from metastases have been the rule in cases of this disease.

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Fig 3 Case I Left lateral and anteroposterior views of the thoracolumbar spine The bodies of the vertebrae are extremely dense and appear almost homogeneous in consistency



Fig 4 Case I Anteroposterior and lateral views of right forearm, and of the left tibia, fibula, and knee joint There is a marked increase in density in these bones Note that the patella also is increased in density

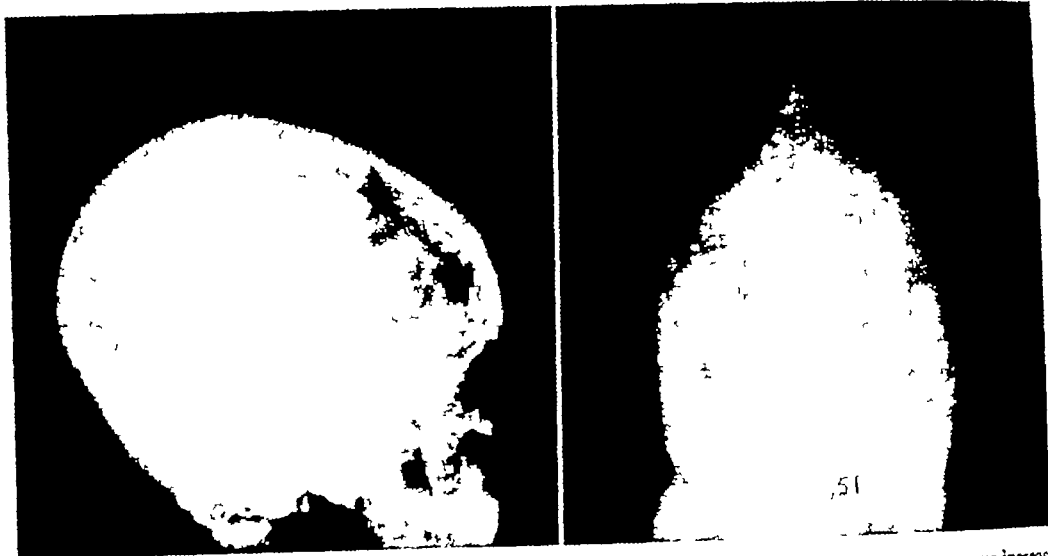


Fig 1 Case I Two views of the skull (left lateral and with occiput down) There is a homogeneous increase in density of all the bones, with thickening of skull tables Diploic bone is as dense as the cortical layers.

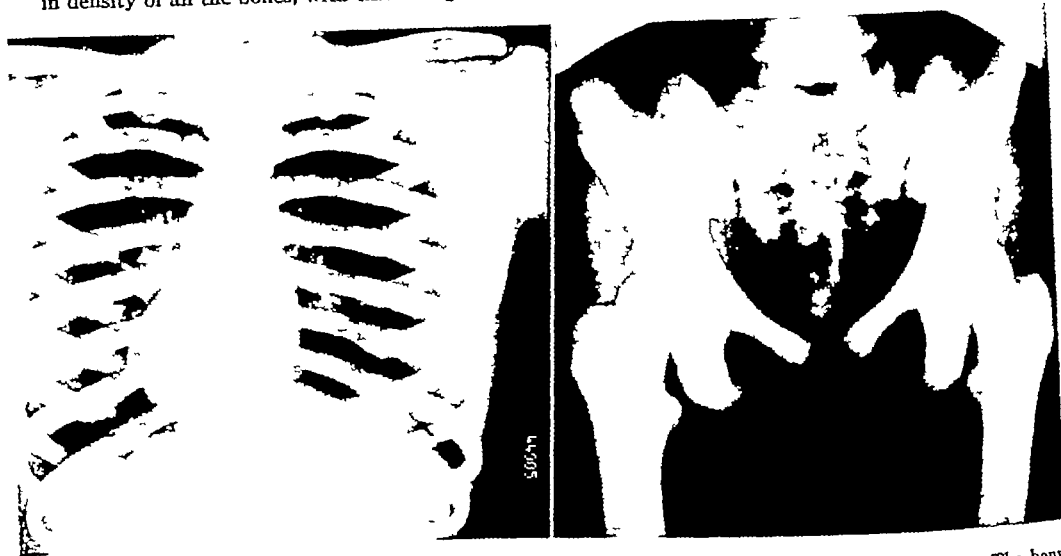


Fig 2 Case I Postero-anterior chest film and anteroposterior film of pelvis and upper femora The bones of the thorax, pelvis, and upper ends of both femora show the dense, compact changes of the disease

both maternal grandparents The paternal grandparents were deceased The disease was found in four of the children but in none of the other members of the family Chart I summarizes the incidence of Albers-Schonberg disease in three generations of the family under discussion Case histories of the affected members of the family follow

CASE I (Figs 1-4) E G P was the first one of the family to be studied radiographically She

is a 17 year old Negro female appearing much older Her requisition for examination read "Disorder of 7th and 8th cranial nerves and intractable headache" Her facial expression was blank and grotesque She was unable to wrinkle her forehead or smile Her mouth was small, with thin lips, and drawn to the left Hearing was impaired on both sides Her mentality was subnormal, with difficulty in remembering and inability to reason well Her speech was slow, with a nasal quality, and difficult to understand

The Hinton and Eagle tests were normal The blood findings were hemoglobin 60 per cent, red cells 4,380,000, white cells 8,250, acid phosphatase





Fig 3 Case I Left lateral and anteroposterior views of the thoracolumbar spine The bodies of the vertebrae are extremely dense and appear almost homogeneous in consistency



Fig 4 Case I Anteroposterior and lateral views of right forearm and of the left tibia, fibula, and knee joint There is a marked increase in density in these bones Note that the patella also is increased in density

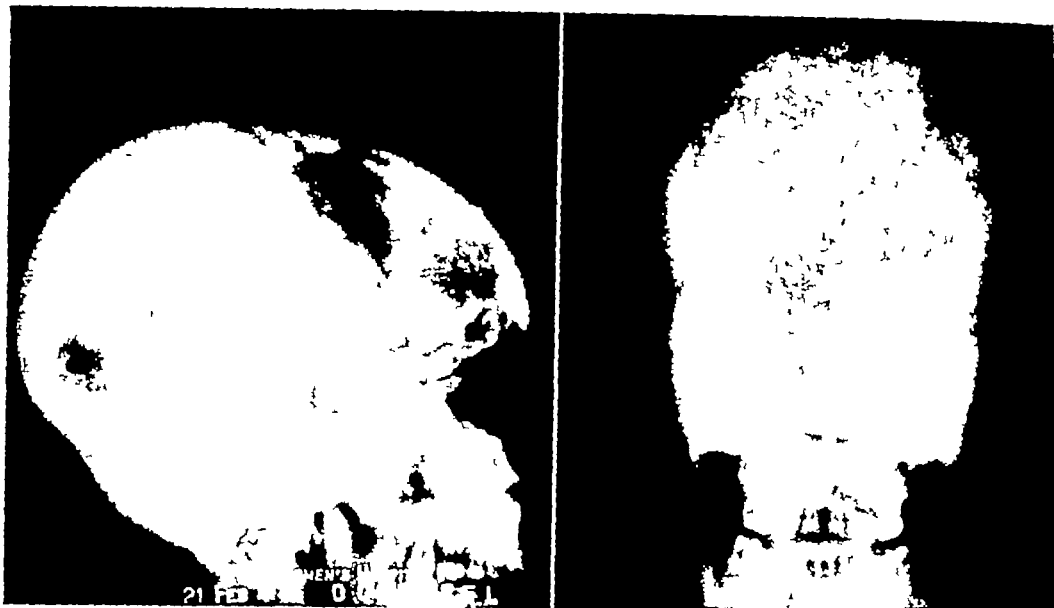


Fig 5 Case II Left lateral view of skull and view with occiput down Thickening of the tables and marked homogeneous increase in density of all the skull bones are apparent.

0.4 unit, alkaline phosphatase, 3 units, calcium, 8.4 mg per 100 c.c. Visual fields were diminished bilaterally.

Roentgenographically all the bones forming the skull were dense, with unusual thickening of the tables. In some places these measured 2.5 cm. Diploic bone appeared as dense and compact as cortical bone. The optic foramina were narrowed. The thoracic cage, pelvis, and bones of the upper and lower extremities showed similar dense, compact changes. Changes in the epiphyses were similar to those in the shafts.

**CASE II** (Figs 5 and 6) M. P., a Negro male 14 years old, like his sister (Case I), appeared older than the age given. His mouth was drawn to the left. His hearing was impaired on both sides. His speech was not clear and, as in the case of his sister, his mentality was below normal. Severe headaches had been present over many months. Laboratory findings showed moderate secondary anemia with 70 per cent hemoglobin. Serologic studies, calcium, phosphorus, and phosphatase were within normal limits. The visual fields were diminished bilaterally.

Roentgenograms of the skull, thorax, pelvis, and long bones showed severe dense bone changes of Albers-Schönberg disease. Both optic foramina were narrowed.

**CASE III** (Fig 7) T. L. P., a Negro male 10 years old, had right-sided weakness of the facial muscles, but the mouth was not drawn to the side. Hearing was slightly impaired on both sides. The patient appeared more intelligent than the two previously described (Cases I and II). Visual fields were di-

minished on both sides, but less so than in the two previous cases. Laboratory tests, carried out as in Cases I and II, showed no abnormal findings with the exception of a moderate secondary anemia.

Dense changes of Albers-Schönberg disease were demonstrable roentgenologically in the bones of the skull, thorax, pelvis, and extremities, but were less severe than in the preceding cases.

**CASE IV** (Fig 8) V. T. P., a Negro male 7 years of age, had bilateral impairment of hearing and right-sided facial weakness, but paralysis of the facial nerve had not taken place. He appeared mentally retarded. The Hinton and Eagle tests were negative. Hemoglobin was 70 per cent, the red cell count 2,440,000, white cell count 7,050. Calcium, phosphorus, and phosphatase were within normal limits.

Roentgenograms showed bone changes in the skull, thorax, pelvis, and long bones characteristic of early Albers-Schönberg disease.

**CASE V** (Fig 9) The case of V. R. P., a 2 year old sister of the other patients, is reported because of the discovery in roentgenograms of the skull of a foreign body (screw) approximately 2 cm in length, deeply embedded in the soft tissues of the floor of the left inferior meatus of the nose. The screw was removed surgically with the child under general anesthesia. No one in the family knew how the screw got into her nose. The service done on this patient was a measure of compensation for the many trips from their tobacco farm in Maryland to the hospital necessary to complete this work. Roentgenograms of the child's skeleton were normal.

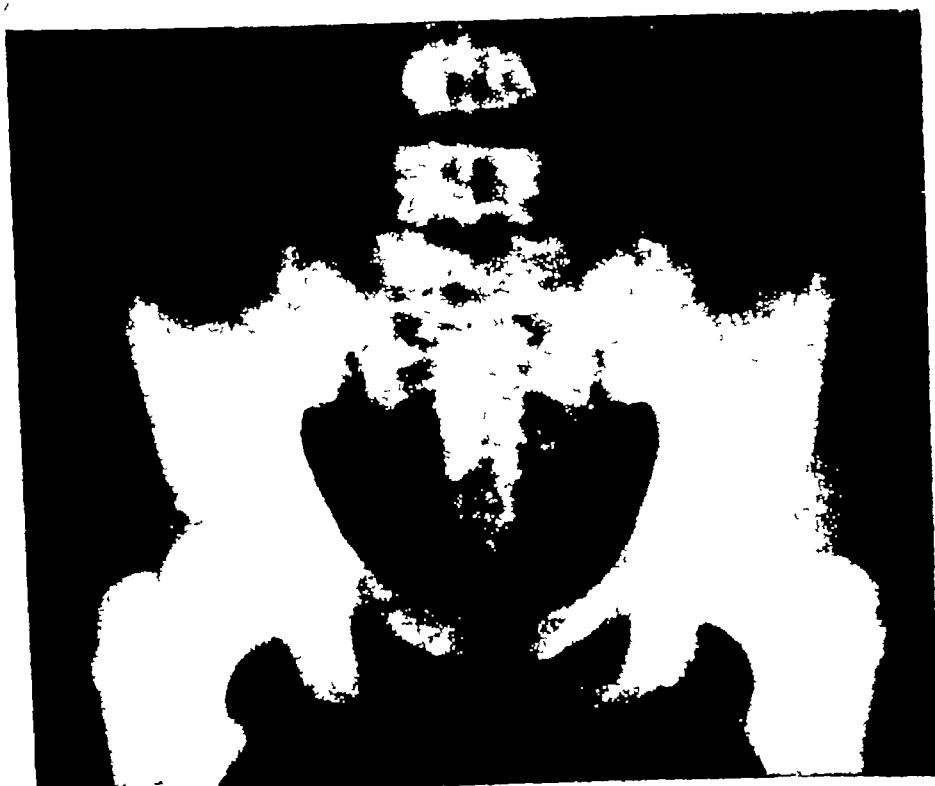


Fig 6 Case II Anteroposterior view of pelvis and right and left optic foramina The pelvis and upper ends of both femora show marked homogeneous increase in density Both optic foramina (indicated by arrows) are narrowed

#### DISCUSSION

"Marble bones" was first described in the literature by Albers-Schonberg (1) in 1904, and the disease has become known as Albers-Schonberg disease According

to Pirie (4), up to 1929 a total of 26 cases had been published Undoubtedly, a great number of additional cases have been seen by radiologists, some of which have been reported. The exact number, is not



Fig 7 Case III Right lateral view of skull and anteroposterior view of pelvis Both the skull and pelvis show fairly marked increase in density



Fig 8 Case IV Left lateral view of skull and anteroposterior view of pelvis Both the skull and pelvis show increase in density, but less marked than in Cases I II and III

known. Excellent bibliographies are supplied by Pirie (4) and Alexander (2), and readers are referred to their papers.

While the etiology of the disease is unknown, its development has been studied by Pirie. He states that the condition begins to develop at the end of the diaphysis and extends into the shaft at or after puberty. Further, he suggests that, in view of the chalky consistency of the bones, which are easily cut by a penknife, and the frequency of fractures, the term "chalky bones" is more appropriate, the term "marble bones" being applicable only in consideration of the appearance on roent-

genograms. There is, however, no general agreement among surgeons that the bones are of chalky consistency as is stated by Pirie.

According to Pancoast, Pendergrass, and Schaeffer (3), although the entire spine is frequently extensively involved, there is no stiffness of the vertebral joints and no encroachment on the intervertebral disks and spinal canal, and there is a remarkable freedom from any arthritic changes.

The severe disabilities attending the disease and its hereditary nature suggest that members of such families should not become parents.

## CONCLUSIONS

1 Four cases of Albers-Schonberg disease occurring in the third generation of a family are reported

2 A radiographic survey of all members of the second generation and the maternal half of the first generation of the family was made. No cases of Albers-Schönberg disease were found in this survey

3 A short discussion of the nature of the disease is included

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Fig 9 Case V Right lateral view of skull. Metallic screw present in upper nares, indicated by arrow.

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# Eosinophilic Granuloma of Bone

Report of a Case with Preoperative Roentgen Diagnosis<sup>1</sup>

MAJ PATRICK RILEY, M.C., A.U.S.

A 25-YEAR-OLD white soldier stationed in the South Pacific was in good health until the latter part of May 1944. At that time, upon lifting a heavy airplane engine part, he first experienced sharp, stabbing pain in the right axilla and beneath the right scapula. Motion of the right arm and shoulder, coughing, sneezing, and deep inspiration reproduced the pain. On occasions he was awakened at night by a heavy, dull aching sensation high in the right axilla.



Fig 1 Roentgenogram of 2nd right rib. Note infiltrative destruction with minimal reaction leaving islands of normal bone and eroding the cortex. Pathological fracture with callus is at the superior border.

Physiotherapy produced only moderate relief, and on June 3, 1944, the patient was admitted to a numbered station hospital. The only finding of significance on physical examination was sharp pain at the medial and inferior border of the right scapula when the arm was abducted beyond 90°. Roentgen examination of the right shoulder disclosed what was described as a localized osteolytic lesion of the 2nd right rib, containing remnants of normal bone. The remaining long bones, skull, and vertebrae showed no similar lesions.

<sup>1</sup> Accepted for publication in December 1945



Fig 2 Gross surgical specimen. Note pathological fracture completed at operation, and grumous mass perforating cortex.

Urinalysis gave normal findings, and tests for Bence-Jones protein were negative. Blood studies showed hemoglobin 17.5 gm, white cells 10,650, with a normal differential count (3 per cent eosinophils), blood calcium 13.5 mg and 13.0 mg on two occasions, blood phosphorus 2.9 mg, sedimentation rate 8 mm per hour (Cutler). A smear for malaria was negative, as was the Kahn reaction.

The patient was evacuated to the continental United States and admitted to a General Hospital on July 21, 1944. Physical examination was entirely negative at this time, range of motion of the right shoulder was normal, and there was neither pain nor tenderness in the axilla or shoulder girdle.

Laboratory findings were essentially the same as previously reported, except that the blood calcium was now 12.3 and 12.6 mg on two occasions, the blood phosphorus was 3.9 and 4.7 mg, and phosphatase 9.2 units (Bodansky). Serum albumin was 4.88 gm and serum globulin 2.42 gm.

The patient was referred to the roentgenological service for examination of the right shoulder, and the following opinion was given on July 27, 1944: "The 2nd right rib at the mid point of its shaft in the mid-axillary line presents an eccentric, oval shaped area of infiltrative destruction with cortical erosion on the medullary side and moderate subperiosteal new bone formation. The lesion has grown in the axial plane of the rib, and though there is subperiosteal new bone formation, there is no soft-tissue mass surrounding the rib to give it a spherical shape. The area of destruction is fairly sharply demarcated

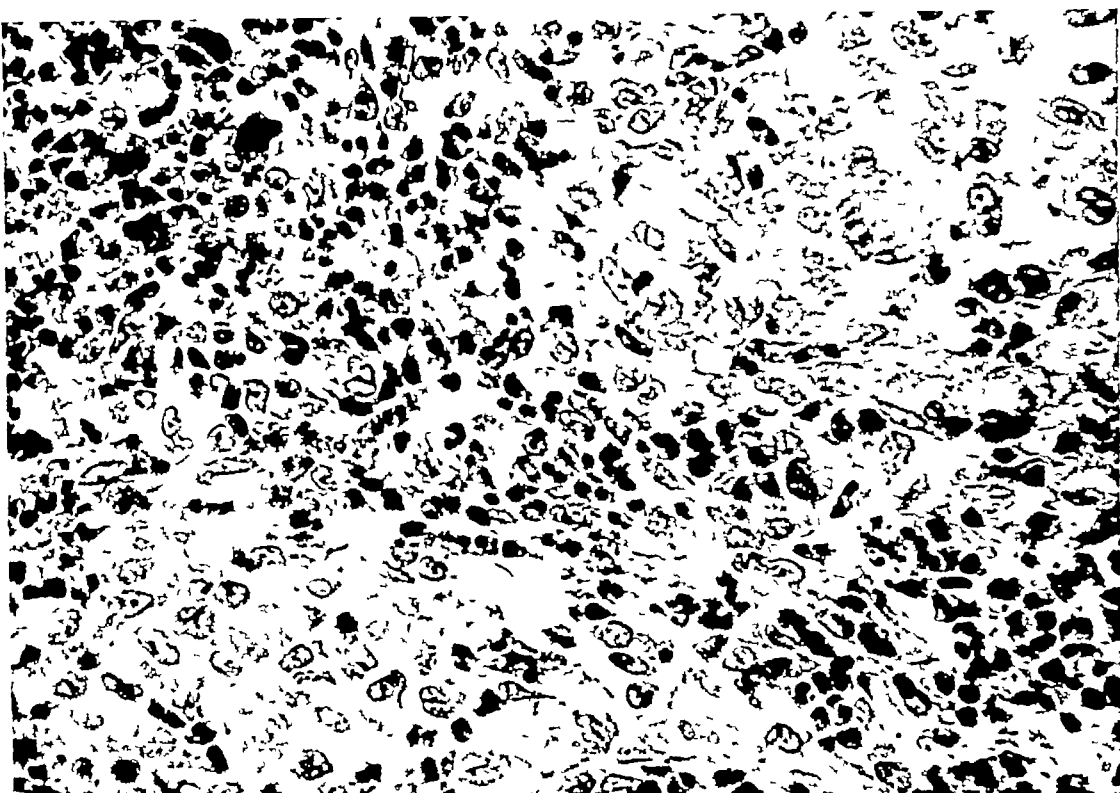


Fig 3 Microscopic section of grumous mass. Note numerous small dark-staining eosinophils intermingling in sheets and cords between the large pale histiocytes.  $\times c 450$

but at the margins the destructive process has infiltrated between the bony trabeculae, leaving small islands of normal bone between areas of destruction. Similarly, in the center of the lesion, where destruction has been most severe, a coarse reticulum of bone remains, giving a faintly honeycombed appearance. The lesion has not expanded the cortex, but it has eroded the cortex on the medullary side at the lower cortical margin. There is no heavy reactionary bone condensation surrounding the lesion, but a light narrow zone of reaction marks the limits of the more proximal margin of the area of destruction. There appear to be two small, incomplete pathologic fractures at the cortex. The area of destruction extends 5 cm along the axial plane of the rib and 2 cm across the transverse diameter.

*Impression.* Although one is inclined to think of malignant neoplasm, criteria for malignancy are not readily evident, since the lesion is oval rather than spherical, because the destruction is infiltrative rather than invasive, and because the cortex is not broken through by the destructive process. On the other hand, the usual manifestations of inflammation are also absent in that there is little or no reactionary bone condensation or reactive subperiosteal calcification, and no soft tissue mass. If the process is inflammatory, it must of necessity

Expandable

tumors, such as giant-cell tumor, are eliminated because of the absence of expansion of the cortex and of typical thin-walled trabeculation. Isolated myeloma of the plasma-cell type does not characteristically present the coarse reticulum or the subperiosteal new bone formation seen here. Osteitis fibrosa cystica would scarcely be expected to present the degree of subperiosteal new bone formation seen here. One destructive benign bone tumor which has been described as having all the characteristics of the lesion observed is solitary eosinophilic granuloma, and it is believed, therefore, that this is such a granuloma" (Fig 1).

The involved portion of the 2nd right rib was then resected subperiosteally. At operation a pathologic fracture was found in the superior cortical border and, in removing the rib, an additional fracture occurred at the inferior border (Fig 2). In the region where the destructive lesion was demonstrable on the roentgenogram there was a grayish-brown tumor of the consistency of guava jelly. This grumous mass completely occupied the destroyed area in the bone and had eroded the cortex severely. Both anteriorly and posteriorly the mass had pierced the cortex in several places and it was infiltrating the rib axially. The cortical perforation had not been apparent on the roentgenogram because superoinferior projection was not possible. The sub-

periosteal new bone described in the roentgen report is probably not an essential feature of the lesion, but rather callus resulting from the pathological fracture, as has been pointed out by Jaffe (1)

Histologic examination of the tissue (Fig 3) disclosed extensive bone destruction. The essential cells were histiocytes of a large polyhedral variety possessing an abundance of pale, somewhat foamy cytoplasm intermingled with masses of eosinophils. In some sections the eosinophils were so numerous that they cast a red glow over the entire slide. The pathologic diagnosis was eosinophilic granuloma of bone.

The patient made an uneventful recovery and six months later was in excellent health and had experienced no further pain or disability in the right shoulder nor in any other organ or system. Roentgen examination revealed moderate progress toward mostosis of the rib defect. The blood calcium had fallen to 10.6 mg and phosphatase to 2.5 units, while the blood phosphorus was 2.42 mg.

#### DISCUSSION

About 50 cases of eosinophilic granuloma of bone have been reported in the American literature. In only three publications (2-4) has it been mentioned that this entity was considered in the preoperative diagnosis, though undoubtedly it was taken into consideration by some of the authors who have reported several cases. The diagnosis was most often made after biopsy.

The present case is reported because the preoperative roentgen diagnosis was made with fair confidence, and for the purpose

of drawing further attention to the entity so that it may more often be considered in differential diagnosis, thus avoiding unnecessarily extensive surgery, as when the lesion is mistaken for malignant neoplasm, or unnecessary drainage when it is mistaken for osteomyelitis.

Given a well localized lesion of bone, exhibiting characteristic infiltrative destruction with little or no surrounding reactive condensation, no soft-tissue mass, and no signs or symptoms other than local pain, in a relatively young person, eosinophilic granuloma of bone ought to be given serious consideration. The presence of multiple lesions should not of itself militate against the diagnosis, since that is not an uncommon occurrence.

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# "Iliac Horns" (Symmetrical Bilateral Central Posterior Iliac Processes)

A Case Report<sup>1</sup>

CAPT E. E. FONG, M.C., A.U.S.

A CASE OF "ILIAC HORNS" (symmetrical bilateral central posterior iliac processes) is reported here because of the extremely unusual nature of the condition.

The patient presenting this anomaly was a 27-year-old woman with a mild

was asked to return for further examination. On this subsequent examination (Figs 1 and 2), the bilateral symmetrical iliac processes were found to arise from the posterior surfaces of the ilia. The processes measured approximately 2.5 cm in diam-



Fig 1 Anteroposterior film showing the "iliac horns," the unusual obliquity of the inferior halves of the sacro-iliac joints, the rather horizontal lumbosacral joints, and the anthropoid type of pelvic inlet.

Fig 2 Right posterior oblique film of the right ilium showing the base and posterior origin of one of the "iliac horns."

hypertension developing during her first pregnancy. She failed to respond to pre-eclampsia treatment, and labor was induced on Sept 17, 1944. A low forceps delivery was made after full dilatation of the cervix and an episiotomy. On Oct 31, 1944, the vascular tension remained slightly elevated, but the urine had become free of albumin. The patient first came under the observation of the writer in January 1945, at which time intravenous pyelography was performed. Nothing unusual was demonstrated in the upper urinary tract, but bilateral smooth-surfaced bony protrusions were observed on the central portions of the ilia, and the patient

eter and projected laterally as well as posteriorly a distance of about 3 cm. The pelvic inlet was somewhat anthropoid in shape posteriorly. The inferior halves of the sacro-iliac joints were considerably more oblique than usual, so that a projection of lines drawn tangential to their surfaces would intersect at approximately a 90-degree angle at the sacrococcygeal junction. The plane of the lumbosacral articulation was more horizontal than usual. Although the patient had never realized the presence of the "iliac horns," these were easily palpable.

We were unable to recall ever having observed such "iliac horns" or reading any account of them. Since a search of the

<sup>1</sup> Accepted for publication in August 1945

medical literature available to us failed to add any information, a copy of one of the films was sent to Dr L H Garland for his opinion and assistance. He, too, had never seen such an anomaly and suggested a search of texts on comparative anatomy and enlistment of the help of the Director of the Army Medical Museum. The latter in turn referred the matter to Colonel A A de Lorimer, Commandant of the

personal search and the opinion of Dr J F Burkholder of the Fresno State College (California) that there is no vertebrate animal which is normally equipped with these posterior "iliac horns."

We are unable to attach any useful function to the "iliac horns," or to explain their etiology.

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Editor's case observed in 1925. Note the similarity of the "iliac horns" to those in the author's patient.

Army School of Roentgenology. A portion of his reply is quoted

"An effort was made to find reference in the literature to this type of anomaly, but to no avail

"We presented these films at one of our Monday evening sessions, where there were in attendance some thirty or forty doctors, including a dozen or more well qualified orthopedic surgeons (Drs Speed, Boyd, Major Flanagan, Captain Haddon, and others from Kennedy General Hospital). No one has seen anything like your case."

Dr Roland H Alden of the Division of Anatomy, University of Tennessee College of Medicine, confirmed the results of our

#### EDITORIAL ADDENDUM

An anomaly similar to that described by the author was observed by the editor in 1925 as an incidental finding in the course of a routine urinary tract examination in a woman of 25 years. His report at that time reads: "There are spur-like processes coming off the posterior surface of both ilia just lateral to the sacroiliac joints. This is apparently a congenital anomaly." There was in this case an associated spina bifida occulta of the upper segment of the sacrum. A roentgenogram is reproduced for comparison with the case reported by Captain Fong, at whose request this note is added.

# EDITORIAL

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## The Regional Irradiation in Malignant Neoplasms

In outlining the most efficient procedure of irradiation for malignant neoplasms, the knowledge of the various ways of metastasis is important. Surgical approach, as a rule, remains confined to the site of the original tumor and the primary regional area, but radiation therapy is much wider in scope. The formerly held view that if a tumor once has spread beyond the first barrier of regional defense the chances for success are practically eliminated does not conform to realities. The not insignificant percentage of five-year survivals in carcinomas with metastases to the secondary regional areas, or even more distant parts of the body, attests to this fact. A few examples are the 15 to 20 per cent five-year survival rate in carcinoma of the breast with metastases to the supraclavicular lymph nodes, a similar percentage in carcinoma of the cervix with invasion of the distant parametria, a 30 per cent five-year survival in lymphosarcomas and seminomas, these latter at times showing quite general metastases.

The major role in the dispersion of malignant neoplasms is played by the lymphatic system. Taylor and Nathanson (1) in an excellent treatise assembled all available information on the rather complicated anatomy of this system and the various factors affecting the distribution of cancer through the lymphatic pathways of different parts of the body. Their chief interest was to establish a proper background for the surgical management of the regional metastases.

According to the evidence found, the cells of malignant neoplasms continue to grow locally for a variable length of time, then they spread by means of emboli or diffuse permeation to the first region of

lymph nodes. Here the metastases remain localized until progressive growth of the cells gradually leads to complete blockage of the lymph flow, when viable malignant cells are forced through fine vessels of anastomosis into the second region of lymph nodes. The process repeats itself, and a similar spread occurs to a third or fourth region of lymph nodes. Eventually the emboli of malignant cells reach the larger lymphatic ducts, being carried into the general blood circulation. According to Taylor and Nathanson, the significant fact is that in this centripetal spread the lymphatic vessels of the lower extremities, abdomen, and part of the thorax merge into the thoracic duct, which ascends through the posterior mediastinum and, after being joined by the trunks of the left upper extremity and of the left side of the neck, empties at the junction of the left internal jugular vein into the left subclavian vein. On the right side, only the considerably smaller trunks of the right upper thorax, right upper extremity, and right side of the neck empty, united or independently, into the corresponding jugulo-subclavian junction.

The most common regions of lymphatic dissemination in malignant neoplasms of a given location are well known and need not be mentioned here. A classical example is the carcinoma of the breast, where the first region lies in the axilla, the second in the supraclavicular fossa, the third in the supraclavicular fossa of the opposite side, and so on. There are, however, certain regions in which the mode of spread is not so evident and therefore their discussion may not appear out of place. Of these, the retroperitoneal and supraclavicular regions occupy the most prominent place.

Attention was first called to the significance of the retroperitoneal region by Desjardins (2) in 1939, who found that it is a metastatic station for a surprisingly large number of malignant tumors. The lymph nodes located in this area form a continuous system with the pelvic lymph nodes. For practical purposes the entire system may be divided into external iliac, internal iliac, common iliac, para-aortic, and mesenteric. The external iliac and internal iliac lymph nodes are located along the corresponding blood vessels and extend up to the bifurcation of the common iliac vessels, whence they continue as the common iliac lymph nodes up to the bifurcation of the abdominal aorta and the inferior vena cava. At this point the two common iliac chains unite to form the para-aortic lymph nodes, which follow the abdominal course of the aorta up to the diaphragm. The mesenteric lymph nodes are arranged along the superior mesenteric artery and its branches.

The regional spheres and the rather complicated interanastomoses of all these lymph node groups conform to the usual pattern, with the exception of the para-aortic group. As a rule, the lymph nodes receive lymph from the organs or tissues of the immediate neighborhood and thus their involvement constitutes the primary or secondary regional dispersion of a nearby malignant tumor. With the para-aortic lymph nodes it is different.

Desjardins described the para-aortic lymph nodes as a chain of twenty-five to thirty rather large nodes lying in front, behind, and to each side of the abdominal aorta and the inferior vena cava. Lymph from organs and structures of the corresponding side of the abdomen flows into them, but there is also anastomosis between the nodes on the right side and those in front or behind the vessels. The upper nodes of the group, moreover, receive a series of lymphatic channels on each side directly from the testis and ovary. These channels follow the course of the spermatic artery in the male and of the ovarian artery in the female. It is interesting that, where-

as in other locations of the body the lymphatic vessels are closely related to the venous system, in the abdomen they are closer to the arteries. The mesenteric lymph nodes also communicate with the para-aortic lymph nodes.

The implications to the radiologist from a more careful study of the retroperitoneal region are manifold. In the first place, it becomes evident that radiation therapy to be successful must be extended beyond the site of the original tumor to include the primary regional and, whenever possible, the secondary regional lymph node metastases. This applies to practically all malignant neoplasms situated within the pelvis or abdomen. Secondly, in case of tumor of the ovary and testis, the upper para-aortic lymph nodes constitute the primary regional area. Only after the tumors have broken through the capsule of these organs and invaded the surrounding structures does the path of lymphatic dispersion change. In ovarian tumors, owing to the situation of the organ, the extension of the malignant process is mostly by implantation of the peritoneum, with subsequent metastases to other lymph node areas. As to most of the abdominal viscera: tumors of the testicle, the rupture of the capsule is followed by invasion along the vas and metastasis to the groin. It appears necessary, therefore, to include the upper para-aortic lymph nodes in the irradiation of all cases of malignant neoplasms of the ovary and testis. This means that the entire pelvis and abdomen must be treated. In the case of seminomas of the testicle, the irradiation is even extended to the chest and both supraclavicular regions. Thirdly, it was noted that in lesions of the lymphatic system proper, the retroperitoneal and in particular the para-aortic lymph nodes often form obscure metastatic stations for a primary focus of almost any location. In other, not altogether rare instances, they constitute the seat of the primary manifestation of the disease, which may remain hidden for a considerable length of time before a more tangible dispersion occurs.

In connection with this latter, Desjardins (3) observed, for example, that the appearance of fever, itching, and cutaneous disturbances during the course of lymphosarcoma or Hodgkin's disease is always indicative of involvement of retroperitoneal lymph nodes, even though no tumor may be palpable. The rapid clearing up of the symptoms following irradiation of the upper abdomen furnishes additional proof of the correctness of the diagnosis. In like manner, a favorable response to irradiation of the upper abdomen points to a primary lymphosarcoma or Hodgkin's disease of the para-aortic lymph nodes when no other diagnostic signs are available. Craver and Herrmann (4) in a recent publication analyzed 406 cases of Hodgkin's disease treated at Memorial Hospital (New York) from 1932 to 1942, inclusive, and found that in 11 per cent there were symptoms suggesting extrinsic gastro-intestinal involvement, most frequently in the retroperitoneal lymph nodes. An even higher incidence has been noted by other investigators.

The significance of the supraclavicular region in the dispersion of malignant neoplasms was studied in detail by Viacava and Pack (5). From a purely clinical point of view the lymph nodes in this region may be divided into two groups, those receiving the afferents from the head, neck, upper portion of the pectoral region, and part of the arms, and those communicating by means of efferents with the brachial groups of the axillary lymph nodes and with the thoracic duct on the left side and the large lymphatic duct or its three branches on the right side. In the first group, primary regional metastasis may occur from malignant neoplasms of the oral cavity, sinuses, pharynx, larynx, and the structures of the skin. In the second, the invasion represents a secondary or tertiary regional spread in a successive chain of lymphatic dissemination by emboli. At times the invasion may occur without affecting the intermediate parts of the chain, in which instance the supraclavicular metastases may constitute the primary

regional dispersion from a more distant focus, as, for example, a carcinoma of the ovary or rectum. The situation is similar to the primary regional metastases in the groin from a malignant neoplasm of the toe, when no other intermediate parts of the lymphatic system of the lower extremity are involved.

Viacava and Pack made a statistical compilation of 4,365 patients with abdominal and thoracic tumors who were treated in the last two decades at Memorial Hospital and found that 122 of these, or 2.8 per cent, presented histologically proved metastases to the supraclavicular region. In 73 patients the metastases were on the left side, in 31 on the right side, and in 18 there was bilateral involvement. Some interesting figures were obtained in regard to the incidence of the supraclavicular metastases from the various organs. For the lung, the figure was 2.8 per cent, for the esophagus 13.2 per cent, for the stomach 8.1 per cent, for the pancreas 8.1 per cent, for the kidneys 6.9 per cent, for the ovaries 6.1 per cent, for the corpus uteri 1.5 per cent, for the cervix uteri 0.8 per cent, for the testes 4.8 per cent, for the prostate 1.9 per cent, and for the rectum 0.2 per cent. No metastases to the supraclavicular lymph nodes were discovered in the records of patients with tumors of the small intestine, gallbladder, or urinary bladder. The metastatic involvement of the right supraclavicular lymph nodes and the bilateral invasion were observed chiefly in thoracic tumors, so that many of them undoubtedly represented primary regional dispersions. In 41 patients of the entire group the supraclavicular metastases constituted the first clinical sign of a malignant tumor, leading to a search for the primary focus.

As in the case of the retroperitoneal region, the early inclusion of the supraclavicular region in the general scheme of irradiation of all suspected cases helps to improve the final results.

The above considerations are important, also, from another point of view. Radical surgical dissection of the lymph nodes

Attention was first called to the significance of the retroperitoneal region by Desjardins (2) in 1939, who found that it is a metastatic station for a surprisingly large number of malignant tumors. The lymph nodes located in this area form a continuous system with the pelvic lymph nodes. For practical purposes the entire system may be divided into external iliac, internal iliac, common iliac, para-aortic, and mesenteric. The external iliac and internal iliac lymph nodes are located along the corresponding blood vessels and extend up to the bifurcation of the common iliac vessels, whence they continue as the common iliac lymph nodes up to the bifurcation of the abdominal aorta and the inferior vena cava. At this point the two common iliac chains unite to form the para-aortic lymph nodes, which follow the abdominal course of the aorta up to the diaphragm. The mesenteric lymph nodes are arranged along the superior mesenteric artery and its branches.

The regional spheres and the rather complicated interanastomoses of all these lymph node groups conform to the usual pattern, with the exception of the para-aortic group. As a rule, the lymph nodes receive lymph from the organs or tissues of the immediate neighborhood and thus their involvement constitutes the primary or secondary regional dispersion of a nearby malignant tumor. With the para-aortic lymph nodes it is different.

Desjardins described the para-aortic lymph nodes as a chain of twenty-five to thirty rather large nodes lying in front, behind, and to each side of the abdominal aorta and the inferior vena cava. Lymph from organs and structures of the corresponding side of the abdomen flows into them, but there is also anastomosis between the nodes on the right side and those in front or behind the vessels. The upper nodes of the group, moreover, receive a series of lymphatic channels on each side directly from the testis and ovary. These channels follow the course of the spermatic artery in the male and of the ovarian artery in the female. It is interesting that, where-

as in other locations of the body the lymphatic vessels are closely related to the venous system, in the abdomen they are closer to the arteries. The mesenteric lymph nodes also communicate with the para-aortic lymph nodes.

The implications to the radiologist from a more careful study of the retroperitoneal region are manifold. In the first place, it becomes evident that radiation therapy to be successful must be extended beyond the site of the original tumor to include the primary regional and, whenever possible, the secondary regional lymph node metastases. This applies to practically all malignant neoplasms situated within the pelvis or abdomen. Secondly, in case of tumors of the ovary and testis, the upper para-aortic lymph nodes constitute the primary regional area. Only after the tumors have broken through the capsule of these organs and invaded the surrounding structures does the path of lymphatic dispersion change. In ovarian tumors, owing to the situation of the organ, the extension of the malignant process is mostly by implantation of the peritoneum, with subsequent metastases to other lymph node areas and to most of the abdominal viscera. In tumors of the testicle, the rupture of the capsule is followed by invasion along the vas and metastasis to the groin. It appears necessary, therefore, to include the upper para-aortic lymph nodes in the irradiation of all cases of malignant neoplasms of the ovary and testis. This means that the entire pelvis and abdomen must be treated. In the case of seminomas of the testicle, the irradiation is even extended to the chest and both supraclavicular regions. Thirdly, it was noted that in lesions of the lymphatic system proper, the retroperitoneal and in particular the para-aortic lymph nodes often form obscure metastatic stations for a primary focus of almost any location. In other, not altogether rare instances, they constitute the seat of the primary manifestation of the disease, which may remain hidden for a considerable length of time before a more tangible dispersion occurs.

## ANNOUNCEMENTS AND BOOK REVIEWS

### ANNUAL MEETING LADIES' ENTERTAINMENT

Under the direction of Mrs. Harold E. Davis, the following program of Ladies' Entertainment has been arranged for the Chicago meeting. Fuller information may be obtained from members of the Chicago Women's Committee at the registration desk.

*Sunday and Monday, Dec. 1 and 2*

Registration at Palmer House

*Tuesday, Dec. 3, 11:00 A.M.*

Tour of Chicago followed by

Luncheon in Club Room of Chicago Art Institute and

Conducted tour through Gallery of Masterpieces of English Paintings by Hogarth, Constable, and Turner, loaned by His Majesty the King, the Museums, and Collectors of Great Britain (Tickets \$3.00)

*Wednesday, Dec. 4, 2:30 P.M.*

Musical and tea at the home of Mrs. Harold E. Davis, 419 Wellington Ave.

### ALABAMA RADIOLOGICAL SOCIETY

A recent addition to the roster of state radiological societies is the Alabama Radiological Society, organized in April 1946. The officers are: Dr. J. A. Meadows, Birmingham, President; Dr. Courtney S. Stickley, Montgomery, Vice-President; Dr. John Day Peake, Mobile, Secretary-Treasurer. The next meeting of the Society will be held at the time and place of the meeting of the Alabama State Medical Association.

### CHICAGO ROENTGEN SOCIETY

The newly elected officers of the Chicago Roentgen Society are: Earl E. Barth, M.D., President; Fay H. Squire, M.D., Vice-President; T. J. Wachowski, M.D., Secretary-Treasurer.

### DR. JOHN S. BOUSLOG HONORED

At the annual meeting of the Colorado State Medical Society, Dr. John S. Bouslog was chosen President Elect. Dr. Bouslog has long been active in the Society, and his election to this high office is a fitting recognition of his services. This is the second time within a two-year period that this honor has been bestowed upon a radiologist. Dr. George A. Unfug, elected in 1944, completes his term as President this year.

### DR. ALBAN KOHLER

Friends of Dr. Alban Kohler, of Wiesbaden, Germany, will be interested to have word of him after the long silence of the war years. In a letter ad-

dressed to Dr. James T. Case, Dr. Köhler writes in part:

"At last once more one can communicate with his good friends and colleagues."

"I have suffered severely from reverses. In 1942 my dear wife was taken from me by death. The first of March 1945, my only son fell on the Eastern Front. He was a pediatrician in Mainz and left a wife and two small children. We, all four, live in a small health resort in which I practice, because, in February 1945, Wiesbaden was bombarded in a severe air attack and I had the misfortune that my house, my dwelling with the large roentgen institute in which I had done my important work, was completely burned down. I lost everything, including my historical library, one of the outstanding in the world, and I have up until now been unable to buy new apparatus."

"That we hunger, you know, but we must be very thankful to America that we are not starving. I have lost fifty-six pounds since the beginning of the war. It is obvious that I would be very fortunate if I could receive a little package, perhaps some honey and tea and a little chocolate."

Dr. Köhler's present address is 16 Nieder-Selters (Taunus), Bernwies 2, Gross-Hessen, Deutschland, American Zone.

## Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

**THE CHEST. A HANDBOOK OF ROENTGEN DIAGNOSIS.** By LEO G. RIGLER, M.D., Professor and Chief, Department of Radiology, University of Minnesota. A volume of 352 pages, with 338 illustrations. Published by The Year Book Publishers, Chicago, 1946. Price \$6.50.

**MEGACOLON IN THE NEWBORN. A CLINICAL AND ROENTGENOLOGICAL STUDY WITH SPECIAL REGARD TO THE PATHOGENESIS.** By THEODOR EHRENPREIS. Supplementum 112 to *Acta chirurgica Scandinavica*, Vol. XCIV (94). A volume of 114 pages, with numerous illustrations. Published by P. A. Morstedt & Söner, Stockholm, 1946.

**MONGOLISM AND CRETINISM. A STUDY OF THE CLINICAL MANIFESTATIONS AND THE GENERAL PATHOLOGY OF PITUITARY AND THYROID DEFICIENCY.** By CLEMENS E. BENDA, M.D., Director, Wallace Research Laboratory for the Study of Mental Deficiency, Wrentham, Mass., Instructor

should be contemplated only when there is ample evidence that the dispersion of the malignant cells is localized to the first regional area. After the dissemination has progressed to the secondary or tertiary lymph nodes, the malignant process is completely out of surgical control. Likewise, operative intervention will prove futile whenever the primary regional metastasis occurs above the customarily established level in the lymphatic chain.

T LEUCUTIA, M D

#### REFERENCES

1. TAYLOR, G W, AND NATHANSON, I T. Lymph Node Metastases. Incidence and Surgical Treatment in Neoplastic Disease. Oxford University Press, 1941.
2. DESJARDINS, ARTHUR U. Retroperitoneal Lymph Nodes. Their Importance in Cases of Malignant Tumors. Arch Surg 38: 714-754, 1939.
3. DESJARDINS, ARTHUR U. Salient Factors in the Treatment of Lymphosarcoma and Hodgkin's Disease with Roentgen Rays. Am J Roentgenol. 54: 707-722, 1945.
4. CRAVER, LLOYD F, AND HERMANN, JULIAN J. Abdominal Lymphogranulomatosis. Am J Roentgenol 55: 165-172, 1946.
5. VLAČAVA, E P, AND PACK, GEORGE T. Significance of Supraclavicular Sentinel Node in Patients with Abdominal and Thoracic Cancer. Arch. Surg. 48: 109-119, 1944.





# RADIOLOGICAL SOCIETIES OF NORTH AMERICA

*Editor's Note*—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M D, Editor, Henry Ford Hospital, Detroit 2, Mich

## UNITED STATES

*Radiological Society of North America*—Secretary, D S Childs, M D, 607 Medical Arts Bldg, Syracuse 2, N Y  
*American Roentgen Ray Society*—Secretary, Harold Dabney Kerr, M D, Iowa City, Iowa  
*American College of Radiology*—Secretary, Mac F Cahal, 20 N Wacker Dr, Chicago 6, Ill  
*Section on Radiology, A M A*—Secretary, U V Portmann, M D, Cleveland Clinic, Cleveland 6, Ohio

## ALABAMA

*Alabama Radiological Society*—Secy-Treasurer, John Day Peake, M D, Mobile Infirmary, Mobile

## ARKANSAS

*Arkansas Radiological Society*—Secretary, Fred Hames, M D, Pine Bluff Meets every three months and annually at meeting of State Medical Society

## CALIFORNIA

*California Medical Association, Section on Radiology*—Secretary, D R. MacColl, M D, 2007 Wilshire Blvd, Los Angeles 5  
*Los Angeles County Medical Association, Radiological Section*—Secretary, Roy W Johnson, M D, 1407 South Hope St, Los Angeles Meets second Wednesday of each month at County Society Building  
*Pacific Roentgen Society*—Secretary, L Henry Garland, M D, 450 Sutter St., San Francisco 8 Meets annually with California Medical Association  
*San Diego Roentgen Society*—Secretary, R F Niehaus, M D, 1831 Fourth Ave., San Diego, Calif Meets first Wednesday of each month  
*San Francisco Radiological Society*—Secretary, Joseph Levitt, M D, 516 Sutter St, San Francisco 2 Meets monthly on the third Thursday at 7 45 P M., first six months of the year in Lane Hall, Stanford University Hospital, and second six months in Toland Hall, University of California Hospital

## COLORADO

*Denver Radiological Club*—Secretary, Washington C Huyler, M D, Mercy Hospital, Denver 6 Meets third Friday of each month, Colorado School of Medicine

## CONNECTICUT

*Connecticut State Medical Society, Section on Radiology*—Secretary, Max Climan, M D, 242 Trumbull St, Hartford 3 Meetings bimonthly, second Thursday

## FLORIDA

*Florida Radiological Society*—Secy-Treasurer, Maxey Dell, Jr, M D, 333 West Main St, S, Gainesville

## GEORGIA

*Georgia Radiological Society*—Secretary-Treasurer, James J Clark, M D, 478 Peachtree St, N E, Atlanta 3 Meets in November and at the annual meeting of State Medical Association

## ILLINOIS

*Chicago Roentgen Society*—Secretary, T J Wachowski, M D, 310 Ellis Ave, Wheaton Meets at the

Palmer House, second Thursday of October, November, January, February, March, and April

*Illinois Radiological Society*—Secretary-Treasurer, William DeHollander, M D, St Johns' Hospital, Springfield Meetings quarterly by announcement

*Illinois State Medical Society, Section on Radiology*—Secretary, Frank S Hussey, M D, 250 East Superior St, Chicago 11

## INDIANA

*The Indiana Roentgen Society*—Secretary-Treasurer, J A Campbell, M D, Indiana University Hospitals, Indianapolis 7 Annual meeting in May

## IOWA

*The Iowa X-ray Club*—Secretary, Arthur W Brskane, M D, 326 Higley Building, Cedar Rapids Meets during annual session of Iowa State Medical Society

## KENTUCKY

*Kentucky Radiological Society*—Secy-Treasurer, Sydney E Johnson, M D, 101 W Chestnut St, Louisville

## LOUISIANA

*Louisiana Radiological Society*—Secretary-Treasurer, Johnson R Anderson, M D, No Louisiana Sanitarium, Shreveport. Meets with State Medical Society  
*Orleans Parish Radiological Society*—Secretary, Joseph V Schlosser, M D, Charity Hospital of Louisiana, New Orleans 13 Meets first Tuesday of each month  
*Shreveport Radiological Club*—Secretary, Oscar O Jones, M D, 2622 Greenwood Road Meets monthly September to May, third Wednesday, 7 30 P M

## MARYLAND

*Baltimore City Medical Society, Radiological Section*—Secretary, Charles N Davidson, M D, 101 West Read St., Baltimore 1

## MICHIGAN

*Detroit X-ray and Radium Society*—Secretary-Treasurer, E R Witwer, M D, Harper Hospital, Detroit 1 Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms

## MINNESOTA

*Minnesota Radiological Society*—Secretary, A T Stenstrom, M D, Minneapolis General Hospital, Minneapolis 26 Meetings quarterly

## MISSOURI

*Radiological Society of Greater Kansas City*—Secretary, John W Walker, M D, 306 E 12th St, Kansas City, Mo Meetings last Friday of each month

*St Louis Society of Radiologists*—Secretary, Edwin C Ernst, M D, 100 Beaumont Medical Bldg Meets on fourth Wednesday of each month, October to May

## NEBRASKA

*Nebraska Radiological Society*—Secretary-Treasurer, Donald H Breit, M D, University of Nebraska Hospital, Omaha 5 Meetings third Wednesday of each month at 6 P M in either Omaha or Lincoln

## NEW ENGLAND

*New England Roentgen Ray Society*—Secretary-Treasurer, George Levene, M D, Massachusetts Memorial

in Neuropathology, Harvard Medical School, Assistant in Psychiatry, Massachusetts General Hospital, Lecturer, Postgraduate Seminar, Massachusetts Department of Mental Health. A volume of 310 pages, with 101 illustrations. Published by Grune & Stratton, New York, 1946. Price \$6.50.

## Book Reviews

**LE FIBRO-MYOME UTERIN** By J. DUCUING, Professeur de clinique chirurgicale à la Faculté de Médecine de Toulouse. Directeur du Centre Anticancéreux. A paper-bound volume of 537 pages with 156 illustrations. Published by Masson & Cie, Paris, 1946. Price 735 francs.

This book of statistics, criticisms, and commentaries on a personal series of 1,300 cases of uterine fibroid (of which 547 have not previously been reported), together with a section on experimental production of fibromyomas and one on the physiology of the irradiated ovary, is a most unique presentation, quite different from the usual textbook. The subject of uterine fibroids—possibly a not important one—is presented in a way to hold the attention almost like a novel. The author, whose interest is primarily surgical, takes up, step by step, his conversion and reversal of opinion which have led him to favor roentgen rays rather than operation for the treatment of 80 per cent of fibroids. One is impressed by his honest, straight thinking and by the lucidity of his presentation. Ducuing has had a very large personal experience with the lesion in point, which entitles him to write with authority. In each sentence he seems to know exactly what he is writing about, and so does his reader.

Throughout the book one notices an over-emphasis on the works of French authors and, to a lesser extent, those of German authors, with a seeming neglect of American writers. This predominance of citation is explainable by the fact that the controversy between surgeons and radiologists over the treatment of fibroids has been more acute on the Continent than in the United States.

The volume is well illustrated and well printed (but not very well bound) on an excellent grade of paper. It has twelve chapters, an extensive bibliography, and a good index. It is not intended for students, but for those who already have some acquaintance with the subject, and may be recommended to every physician who is interested in uterine fibromyomas. It should appeal especially to surgeons, radiologists, and others who want to know the opinions of one thoroughly qualified to discuss the diagnosis and treatment of this condition.

**PRECIS DE RADIOLOGIQUE** By P. VAN PÉE, Professor of Radiology at the University of Liège. A volume of 382 pages, with 214 figures and 6 roentgenographic prints. Published by Masson & Cie, Paris, 1946.

Van Pée's *Precis de radiologie* may be recommended as a compact handy reference book of diagnostic roentgenology. In a clear but concise manner it touches upon nearly every phase of the subject. It appears to have been written primarily for students, since the text is to a certain extent presented in short paragraphs, suggesting a syllabus for lecture purposes. Unfortunately, in the attempt to cover the whole field of diagnostic roentgenology in a compass of 382 pages, the author has had to present the subject matter in such a condensed form that some important information has necessarily been sacrificed.

The material presented is informative and represents a modern concept of diagnosis by a roentgenologist of wide experience. The author stresses the fact that while many conditions lend themselves to a definite roentgenologic diagnosis, most often the roentgenologist, being a physician, should have all the clinical and laboratory information concerning the case before reaching a final conclusion.

The text is well illustrated with diagrams and excellent photographic reproductions printed on heavy paper. A chapter on the physics of roentgen rays serves as a useful introduction to the chapter on diagnosis.



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Hospitals, Boston, Mass Meets monthly on third Friday at Boston Medical Library

## NEW HAMPSHIRE

*New Hampshire Roentgen Society*—Secretary-Treasurer, Richard C Batt, M D, St Louis Hospital, Berlin

## NEW JERSEY

*Radiological Society of New Jersey*—Secretary, W H Seward, M D, Orange Memorial Hospital, Orange Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called

## NEW YORK

*Associated Radiologists of New York, Inc*—Secretary, William J Francis, M D, East Rockaway, L I

*Brooklyn Roentgen Ray Society*—Secretary-Treasurer, Abraham H Levy, M D, 1354 Carroll St, Bklyn 13 Meets fourth Tuesday of every month, October to April

*Buffalo Radiological Society*—Secretary-Treasurer, Mario C Gian, M D, 610 Niagara St, Buffalo 1 Meetings second Monday evening each month, October to May, inclusive

*Central New York Roentgen Society*—Secretary-Treasurer, Carlton F Potter, M D, 425 Waverly Ave., Syracuse 10 Meetings in January, May, and October

*Long Island Radiological Society*—Secretary, Marcus Wiener, M D, 1430 48th St, Brooklyn 19 Meetings fourth Thursday evening each month at Kings County Medical Bldg

*New York Roentgen Society*—Secretary, Wm Snow, M D, 941 Park Ave., New York 28

*Rochester Roentgen-Ray Society*—Secretary, Murray P George, M D, 260 Crittenden Blvd, Rochester 7 Meets at Strong Memorial Hospital, third Monday, September through May

## NORTH CAROLINA

*Radiological Society of North Carolina*—Secretary-Treasurer, James E Hemphill, M D, Professional Bldg, Charlotte 2 Meets in May and October

## NORTH DAKOTA

*North Dakota Radiological Society*—Secretary, Charles Heilman, M D, 1338 Second St, N, Fargo

## OHIO

*Ohio Radiological Society*—Secretary, Henry Snow, M D, 1061 Reinbold Bldg, Dayton 2 Next meeting at annual meeting of the Ohio State Medical Association

*Central Ohio Radiological Society*—Secretary, Hugh A. Baldwin, 347 E State St., Columbus

*Cleveland Radiological Society*—Secretary-Treasurer, Carroll C. Dundon, M D, 11311 Shaker Blvd, Cleveland 4 Meetings at 6 30 P.M. on fourth Monday of each month from October to April, inclusive,

*Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists)*—Secretary-Treasurer, Samuel Brown, M D, 707 Race St, Cincinnati 2 Meetings held third Tuesday of each month

## PENNSYLVANIA

*Pennsylvania Radiological Society*—Secretary-Treasurer, L E Wurster, M D, 416 Pine St, Williamsport 8  
*Philadelphia Roentgen Ray Society*—Secretary, Calvin L Stewart, M D, Jefferson Hospital, Philadelphia 7 Meets first Thursday of each month at 8 00 P.M., from October to May in Thomson Hall, 21 S. 22d St.

*Pittsburgh Roentgen Society*—Secretary-Treasurer, Lester M J Freedman, M D, 415 Highland Bldg, Pittsburgh 6 Meets second Wednesday of each month at 6 30 P.M., October to May, inclusive

## ROCKY MOUNTAIN STATES

*Rocky Mountain Radiological Society*—Secretary, A. M. Popma, M D, 220 N First St, Boise, Idaho

## SOUTH CAROLINA

*South Carolina X-ray Society*—Secretary-Treasurer, Robert B Taft, M D, 103 Rutledge Ave., Charleston 16

## TENNESSEE

*Memphis Roentgen Club*—Meetings second Tuesday of each month at University Center

*Tennessee Radiological Society*—Secretary-Treasurer, J Marsh Frère, M D, 707 Walnut St., Chattanooga Meets annually with State Medical Society in April

## TEXAS

*Dallas-Fort Worth Roentgen Study Club*—Secretary, X. R Hyde, M D, Medical Arts Bldg, Fort Worth 2 Meetings on third Monday of each month, in Dallas the odd months and in Fort Worth in the even months.  
*Texas Radiological Society*—Secretary-Treasurer, R. P O'Bannon, M D, 650 Fifth Ave., Fort Worth 4

## UTAH

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## ROENTGEN DIAGNOSIS

### THE HEAD AND NECK

**Intracranial Angiography I The Diagnosis of Vascular Lesions** Carl F List and Fred J Hodges *J Neurosurg* 3 25-45, January 1946

This article on intracranial angiography in the diagnosis of vascular lesions is of especial interest as a supplement to the paper by List, Burge, and Hodges in *RADIOLOGY* 45 1, 1945. The authors report their observations in 35 cases of vascular intracranial lesions, which they divide as follows (1) vascular occlusions and coarctation, (2) intracranial aneurysms, (3) arteriovenous fistulas, and (4) congenital arteriovenous malformations. Eighteen illustrative case reports are included.

**Arteriovenous Aneurysms of the Scalp and Face.** Walter E Dandy *Arch Surg* 52 1-32, January 1946

Nine cases of arteriovenous aneurysm of the scalp and face are reported, 8 congenital and 1 acquired as a result of trauma. In the 7 cases in the scalp, the arterial supply was traced to the middle meningeal artery. In 1, the branches came through the parietal foramina, in the other 6, numerous arterial branches penetrated the bone. In 3 the aneurysm was demonstrated in the brain at operation, and in 2 other patients in whom the brain was not exposed, intracranial involvement was believed to be present, all of these patients had hemianopsia. Convulsions were present in 4.

Radiographic studies showing dilated arterial paths may be important. Intracranial calcifications are especially important as proving intracranial involvement.

The safest treatment is extirpation of the central mass, which causes disappearance of the external pulsating veins. Injections, although more dangerous, sometimes lead to good results and are to be preferred in some cases, as when the scar would be disfiguring. In the presence of intracranial involvement, their use is especially hazardous. Ligation of the external (not the common) carotid is usually unnecessary, although it may be required in occasional cases. Ligation of the arteries of the scalp is useless.

LEWIS G JACOBS, M D

**Pneumosinus Dilatans** Hans Brunner, Irwin G Spiesman, and John J Theobald *Ann Otol, Rhin & Laryng* 54 763-785, December 1945

Pneumosinus dilatans, a pneumatocele of the paranasal sinuses characterized by dilatation of the involved sinus with air, was described by Benjamins in 1918 (*Acta otolaryng* 1 412, 1918). The authors briefly summarize Benjamins' case and other cases to which he referred, describe the essential features of several examples from the subsequent literature, and present four new cases. The first of their own series they consider a perfect example of the condition which is referred to as pneumosinus frontalis dilatans. It demonstrates the slowly growing tumors over both eyebrows, the moderate degree of headache, the huge frontal sinuses, the walls of which are thin and without obvious defect, the absence of fluid in the sinuses, and the obstruction of the nasofrontal duct. The patient was operated upon but the result was unsatisfactory. Certain acromegalic features were present, and x-ray studies eventually revealed enlargement of the sella

turcica and partial destruction of the posterior clinoid processes, leading to a diagnosis of adenoma of the hypophysis and incipient acromegaly.

In the three other cases recorded, involving the right maxillary and sphenoid sinuses, the right maxillary sinus, and the ethmoid sinus, respectively, there were also bony changes affecting the walls of the dilated sinuses, due to a focal osteitis in two instances and probably to an old fracture in the third.

From an analysis of this group of cases, the authors conclude that in certain alterations of the bone the sinuses become dilated on account of the bone disease. Why some alterations of the bone, such as osteitis deformans, generalized osteitis fibrosa or leontiasis ossea, usually cause an obliteration of the sinuses while other alterations cause the opposite finding, it is not possible to explain fully. The time when the bone alteration sets in would seem, however, to play a role. If the disease begins at a time when the paranasal sinuses are developed, it may narrow the sinuses provided the disease is not destructive, but productive, in character. *If the bone alteration begins at a time when the sinuses are not yet developed*, as was true in the cases reported, the result may be an absence or a dilatation of the sinus. The latter finding is obtained in acromegaly, focal osteitis fibrosa, and fractures, while an osteomyelitis, for example, usually prevents the formation of a paranasal sinus.

Pneumosinus dilatans is thus not a morbid entity but a symptom of a skeletal disease, which may be focal or systemic in character. The dilatation of the sinuses is bilateral when the bone alteration is systemic, as in acromegaly, unilateral when the bone alteration is unilateral, as in focal osteitis or fracture.

STEPHEN N TAGER, M D

### THE CHEST

**Anatomy of the Blood Vessels of the Human Lung as Applied to Chest Radiology** Thomas Lodge *Brit J Radiol* 19 1-13, January 1946

For this study of the anatomy of the pulmonary vessels, three methods were used, celloidin models prepared by the corrosion technic, radiography following injection of the vessels with barium sulfate suspension, and tomography on living subjects.

There is a basic pattern of the blood vessels of the lungs, in general following the bronchial distribution. The relations of the artery, bronchus, and vein described by Greiner's law (artery, bronchus, and vein are found in that order, proceeding counter-clockwise in the right lung and clockwise in the left lung) were confirmed. Except in the upper lobes, variations from this basic pattern are uncommon, though there may be duplications, i.e., two parallel vessels instead of one. In the upper lobes, two variations are commonly found, one in which the vessels come from a main trunk like the branches of a tree, the other in which the branches arise from a common basic vessel like the stems of a bush.

After proceeding obliquely upward for a short distance, the right upper lobe artery divides into three branches: the apical, which goes upward and outward toward the apex, the axillary, which may be oblique or almost horizontal, the pectoral, which passes forward horizontally to the anterior and lowest portion of the

lobe. There are four main veins which drain the areas indicated by their names subpleural mediastinal, apical, pectoral, and axillary (The terminology used is chiefly that of Ewart for the arteries and Herrnheiser for the veins)

The right pulmonary artery, continuing as the intermediate artery, gives off (1) a middle descending trunk, the lower lobe artery, (2) a posterior horizontal trunk which passes upward, outward, and backward to the apical portion of the right lower lobe, (3) an anterior and medial trunk, the right middle lobe artery. Soon after entering the lobe, the right middle lobe artery divides into two branches, the sternocardiac and the superficial mammary cardiac. There are two chief veins in the right middle lobe, the paramediastinal and the costal.

The lower lobe artery proceeds downward, outward, and slightly backward, becoming external to the lower lobe bronchus, and gives off the retrocardiac, anterior basal, axillary basal, and posterior basal arteries. The last lies posterior to its bronchus. The veins of the right lower lobe are not well standardized. In general, there are five, named for the location they drain: apico-horizontal, anterior basal, anterior axillary basal, posterior basal, and posterior axillo-basal. They proceed upward and inward, uniting to form the inferior pulmonary vein.

The vessels of the left lung are homologous to those of the right, with the lingular portion of the upper lobe corresponding to the right middle lobe. There is more variation in the arteries of the left upper lobe. Frequently there are only three, a pectori-apical, axillary, and lingular. The veins follow the same pattern as the arteries.

These vessels may be demonstrated by tomography down to the second branchings if care is used in positioning and "contrasty" films are produced.

SYDNEY J. HAWLEY, M.D.

**Respiratory Malformations Types, Causes and Significance. A Preliminary Report.** Hovey Jordan. *Am Rev Tuberc* 53 58-70, January 1946.

Structural anomalies of the respiratory system may be divided into two major groups: (1) those which are connected with or are a part of the respiratory system, such as abnormal fissures or lobes of the lung itself and agenesis of a lung, (2) those having no morphological connection with the respiratory system. Anomalies of this latter group may be further divided into two subgroups. One of these includes anomalous lobes which are attached by a peduncle to some non-respiratory organ or structure, as the posterior mediastinum, diaphragm, etc., the other comprises anomalous respiratory tissue, more or less cystic in nature, incorporated in the wall of a non-respiratory organ. This type might be considered by some as belonging to the general group of "bronchogenic cysts" but the author prefers to limit the latter term to cysts having a more or less complete connection with the respiratory system and thus more subject to disease.

Two cases of anomalous lobes without connection with the respiratory system are described. The various theories as to the cause for such anomalies are discussed in some detail. The theory of independent evagination of the anlage of the anomaly from the early embryonic gut, because of its faulty differentiation into respiratory instead of gut tissue at the site of evagination, seems to the author to be the most likely explanation.

Considering all types of respiratory malformations, including such variations as azygos and inferior accessory lobes, it is believed that the incidence is about 1 or 2 per cent in the general population. The possibility of disease occurring in an anomalous structure is no greater than in normal lung, and in such structures not connected to the respiratory system it is less.

L. W. PAUL, M.D.

**Bronchial Obstruction in Infants and Children.** Paul H. Holinger and Ralph G. Rigby. *M Clin North America* 30 105-119, January 1946.

The presentation of 3 cases illustrating the basic forms of bronchial obstruction is followed by a general discussion of the symptomatology and physical findings.

The roentgen diagnosis of bronchial obstruction depends upon complete study of the chest. The practice of basing an interpretation on one or two views leads to gross errors not only regarding the presence or absence of an obstruction but also the location of the lesion. Fluoroscopically, areas of density or emphysema, the motion of the diaphragm, and the shifting position of the heart and mediastinum on inspiration and expiration are significant. There are no actual roentgen findings in the by-pass type of valve obstruction, unless the obstructing element is an opaque object. In bronchial obstruction of the check- or ball-valve type the fluoroscopic study is of the greatest importance. It demonstrates an increase in the transparency of the affected lung, a depression and limitation of motion of the diaphragm on the involved side, a displacement of the heart and mediastinal structures toward the uninvolved side on expiration, and finally a compensatory increase in the motion of the diaphragm on the uninvolved side.

Obstructive emphysema may be recorded on the roentgenogram by making exposures at extremes of the respiratory cycle and comparing the position of the diaphragm and mediastinum as well as the density of the lungs on the two exposures. In complete obstruction, the roentgen findings are more obvious because of the area of density distal to the obstruction. When the main bronchi are completely obstructed, the heart and mediastinal structures are shifted toward the involved side during both phases of respiration, and the diaphragm is elevated and fixed on that side, with density of the atelectatic lung. Complete obstructions of bronchi leading to single lobes or parts of lobes have less influence on the heart and mediastinal structures, although they usually give roentgen evidence of a shift of these structures toward the involved side, thus aiding in the differentiation between an atelectasis, a pneumonic consolidation, and a drowned lung. Atelectatic lobes or parts of lobes generally assume a more or less triangular shape and are frequently designated as triangular shadows, the bronchial obstruction generally lying at the apex of the triangle. It is essential, however, that the shadow be studied roentgenographically in two planes to localize accurately the particular obstructed bronchus.

**"Tuberculous" Bronchitis.** Hanns Alexander. *Schweiz med Wchnschr* 76 47-50, Jan 19, 1946.

Bronchitis occurring in a tuberculous patient is not necessarily tuberculous. With care the true tuberculous type can be distinguished, which is desirable from a therapeutic standpoint.

Recurrent "associated" bronchitis is an accompaniment of an active exudative tuberculosis. It is more common in women, especially in the premenstrual period. It is thought to be due to the development of new pulmonary foci which produce a hyperemia with narrowing of the bronchi. This in turn predisposes to activation of the non-specific catarrhal bronchial infection which accompanies almost all cases of tuberculosis. Therapy includes general measures, a climate without sharp changes, expectorants (never narcotics!), etc.

Allergic bronchitis is paroxysmal. It has been described as "eosinophilic bronchial catarrh." Often it precedes the tuberculosis, and it may be accompanied by asthma. The sputum usually contains eosinophils, and a high eosinophil count in the blood is even more common. Inspiratory and expiratory squeaks and groans may be heard over the chest. The onset may be sudden. Treatment is the same as for asthma.

Stasis bronchitis may be associated with tuberculosis as a result of the circulatory changes secondary to the disease. Diagnosis depends on the demonstration of a right heart failure, the condition improves strikingly following improvement in the circulation.

True bronchial tuberculosis, especially involving the bronchioles, is not uncommon, it may even push the parenchymal changes into the background. An outstanding characteristic is its tendency to produce focal atelectasis. Differentiation is important for prognosis and determination of the proper type of therapy. Pneumothorax is often the cause of massive collapse of the lung, with permanent atelectasis of a part or all. Thoracoplasty often leads to bronchial dissemination. The author has used gold therapy with some success.

A picture similar to tuberculous bronchitis may be the result of a post-tuberculous bronchiectasis, which leads to a chronic, recurrent bronchial catarrh.

LEWIS G. JACOBS, M.D.

#### Early Diagnosis of Minimal Pulmonary Tuberculosis

I. D. Bobrowitz and Ralph E. Dwork. *New England J. Med.* 234: 10-14, Jan. 3, 1946.

The authors studied 200 cases of minimal pulmonary tuberculosis (consecutive sanatorium admissions). Sixty-seven of the group had had some contact with the disease, and the importance of x-ray examination of all persons in contact with tuberculous patients is stressed. All but 37 of the 200 patients had symptoms—cough, expectoration, loss of weight, weakness, fever, hemoptysis, night sweats, streaking, dyspnea, anorexia, chills, hoarseness, and lesser complaints. While there is no characteristic or specific symptom of tuberculosis, any of the complaints listed should suggest the possibility of the disease and lead to x-ray examination of the chest. Râles are the most important diagnostic physical finding but were present in only 57 of these minimal cases. In 156 patients no tubercle bacilli were recovered from the sputum or gastric contents. Thus, while the demonstration of bacilli is proof positive of infection, their absence is not to be taken as excluding it. Repeated examinations are desirable, but it is not necessary to wait for a positive specimen before making a diagnosis, since early x-ray examination will indicate the disease.

X-ray examination was the chief method of diagnosis in this series, having been done in 187 of the 200 cases. In 97 it was employed to confirm suspected tuberculosis, and in 90 a routine examination led to the discovery of

the disease. "Certainly," the authors say, "in over 99 per cent of minimal cases it can effect the diagnosis, often long before other clinical or laboratory findings have indicated the disease. No lung examination can be considered complete without an x-ray examination, and a patient should never be told that tuberculosis is absent unless one has been done. This procedure should be employed in every patient with any symptoms suggestive of tuberculosis, in any illness that tuberculosis may simulate, and periodically in all contact cases." By x-ray examination the authors mean radiography. They mention fluoroscopy, but consider it "an imperfect diagnostic method."

JOHN B. MCANBENNY, M.D.

#### Tuberculous Cavities and Pneumoperitoneum. N. C. Browne and F. L. Corrigan. *Irish J. M. Sc.*, December 1945, pp. 697-702.

The authors base their approach to the treatment of pulmonary tuberculosis on the premise that in a large percentage of cases a tuberculous cavity means the death of the patient in a relatively short time. Almost invariably it is a post-primary manifestation of the disease.

Following the deposition of the tubercle bacillus, there is tissue destruction and ulcer formation. The subsequent development of this ulcer is conditioned by the concentric elastic pull of the surrounding tissue, the continuously changing subatmospheric intrapleural negative pressure associated with respiratory movement, the fact that, as a result of interaction of tissue destruction and elastic tension, one or more bronchi of progressively larger size communicate with the ulcer, which is evacuated of its content. The combined action of the first two factors produces a gradual though limited enlargement of the ulcer. The first line of active treatment has been based on a neutralization of these two forces and is achieved ideally in a selective artificial pneumothorax, whereby both reduction of respiratory movement and concentric relaxation of the lung are effected. Despite treatment, however, some cavities remain open. The authors believe that their persistence is due to the presence of an unchanged condition of partial bronchial stenosis.

Pneumoperitoneum not only brings about relaxation by the reduction of the hemithorax in an apico-caudal direction, but converts the partial bronchial stenosis into a complete block by compressing and kinking the bronchus leading to the cavity. As shown by Coryllos (*J. A. M. A.* 100: 480, 1933), concentric relaxation around a patent tuberculous cavity where there is complete block of the draining bronchus will be followed by air absorption and cavity closure. The present writers have found pneumoperitoneum to be a technically simple, easily reversible, and uncomplicated procedure which can be of definite value in lesions situated in the base or mid-zone of either lung, in the treatment of otherwise uncontrollable hemoptysis "by increasing the rise obtained by a phrenic crush," to provide apicocaudal relaxation in cases of inoperable apical adhesions in artificial pneumothorax when a major operation is contraindicated, in the treatment of potential artificial pneumothorax in cases too toxic for immediate collapse. Apical cavities have not responded well to pneumoperitoneum, though an improvement is usually seen with reduction in the size of the cavity. The technique of the procedure and its possible complications are described.

From a radiographic standpoint, several observations are made. There is some cardiac distortion, more marked in a left pneumoperitoneum. The liver swings downward toward the middle line, and the gas bubble in the stomach is no longer seen. The spleen is often well outlined. When the sputum is persistently positive over a reasonable period of time, an overpenetrated roentgenogram is desirable, as a patent cavity may be seen to have been pushed up behind the heart. Fluoroscopic examination shows the air bubble to travel around the abdomen with movement of the patient, always occupying the highest point of the abdominal cavity. On lateral fluoroscopic examination, the major portion of the movement of the descending bubble of air under the diaphragm on inspiration is accommodated by forward bulging of the anterior abdominal wall. A corset or tight binder may be used to support a flaccid abdomen to some extent and prevent this excessive bulging.

The authors have used pneumoperitoneum in 45 cases but, as indicated above, they consider its value limited and believe it is unlikely to replace pneumothorax, especially in the treatment of apical and upper mid-lung cavities. In their own cases conversion to artificial pneumothorax was attempted wherever possible, and they believe that selective artificial pneumothorax is still the most desirable form of pulmonary collapse.

BERNARD S. KALAYJIAN, M.D.

#### Results of a Random Chest X-ray Survey of Healthy Troops in Canada. R. W. Boyd. Canad. M. A. J. 54: 16-19, January 1946.

In order to estimate the incidence of early tuberculosis and to forecast the number of cases of tuberculosis arising among troops in Canada on demobilization, a spot x-ray survey was made of healthy military personnel serving in Canada. More than 5,000 soldiers were selected for this study. The soldiers were all under thirty-five years of age and had all served in Canada continuously for eighteen months or more. None of these had received a chest x-ray examination during this eighteen-month period. The individuals were chosen at random from the various units scattered over Canada. Single 14 X 17-inch films were made, and were interpreted by local military radiologists and were again reviewed by one radiologist at National Defense Headquarters.

Three cases of active pulmonary tuberculosis were discovered, and in 8 cases the findings were suspicious of minimal tuberculosis. Of the 8 suspects, 4 were found to have no disease after four months follow-up and 4 were continued on periodic observation. Twenty-eight men had fibrotic or semicalcified lesions which had been present at enlistment and showed no change. Six others had similar fibrotic changes which showed resolution or healing. Fifty-nine had gross hilar or parenchymal calcifications. One had subacute non-tuberculous pleurisy. One hundred and fourteen had some pleural thickening, not of clinical significance. Two had progressive heart disease. Four had atypical pneumonia or basilar infection. One had spontaneous pneumothorax. One had eventration of the diaphragm, and two had residual lipiodol in the lung fields.

Of the three cases of active tuberculosis 2 were moderately advanced, with cavity formation, the third was minimal.

If the findings of the random survey are applicable

to incidence of hidden or unrecognized tuberculosis of the army in Canada, a rate of considerably less than one per thousand may be arrived at. The findings of the routine random survey indicate the value of re-surveying "normal" individuals at periodic intervals.

BERNARD S. KALAYJIAN, M.D.

#### Annular Areas of Pulmonary Rarefaction in Children. Eileen Phillips and Chester A. Stewart. New Orleans M. & S. J. 98: 247-252, December 1945.

Because of increasing use of the x-ray, pulmonary cysts and cyst-like areas of rarefaction are being discovered with increasing frequency. These changes may be congenital in origin or secondary to aspirated foreign bodies, lung abscesses, and partial bronchial obstruction associated with infections of the respiratory tract.

The authors present four cases illustrating some of the difficulties which attend diagnosis, particularly when infection accompanies the presence of cyst-like changes in the lungs of children.

ELLWOOD W. GODFREY, M.D.

#### Roentgenologic Findings in the Lungs of Victims of the Coconut Grove Disaster. Maxwell Finland, Max Ritvo, Charles S. Davidson, and Stanley M. Levenson. Am. J. Roentgenol. 55: 1-15, January 1946.

The report of Schatzki (Ann. Surg. 117: 841, 1943; Abst. in Radiology 42: 301, 1944) on the roentgenologic aspects of the pulmonary lesions in the cases from the Coconut Grove fire seen in the Massachusetts General Hospital is reviewed. The various types of roentgenographic lesions described by him were: (1) atelectasis, which varied from lobar to lobular (more common), (2) emphysema, lobar and lobular in distribution, occurring along with areas of atelectasis in the same lung, (3) milary mottling of both lungs with individual lesions measuring 2 to 6 mm in diameter, observed in 2 fatal cases only, (4) pulmonary edema in the same 2 fatal cases. Infarcts, though seen at autopsy, were not recognized roentgenologically.

The cases upon which the present paper is based were seen in the Boston City Hospital, and the authors have described the clinical features of the series elsewhere. Autopsy findings suggested that the clinical manifestations in the severe cases were the result of varying degrees of obstruction due to the pseudomembrane and the viscid exudate which covered the tracheobronchial tree and often extended down to the small bronchioles. These gave rise to patches of atelectasis in some parts of the lung while in other parts there were areas of emphysema and dilated bronchi due to trapped air beyond the obstructing lesions.

A fairly close correlation was found to exist between the severity of the respiratory symptoms and the extent of the roentgen changes. The latter were essentially the same as those described by Schatzki. The diffuse milary type of mottling in large areas of the lung was seen more frequently in the early films. Enlargement of the hilar shadows with accentuated bronchial markings was quite frequent. Emphysema was evidenced by patchy areas of increased radiance. Atelectasis manifested by the various types of density described by Schatzki was seen in most of the positive roentgenograms. In addition, there were several cases in which the findings were interpreted as those of partial atelectasis of most of one lobe or one lung. In some cases there

were elevation of the diaphragm, contraction of the intercostal spaces, and an appreciable though not marked shift of the mediastinal contents to the affected side. Extensive pulmonary edema was not found.

In general, the more extensive roentgenographic lesions had largely cleared before the end of the first week. In a few instances, there was marked fluctuation in both physical and roentgen findings, as might be expected. Follow-up roentgen examinations in inspiration and expiration were done in many of the patients who had moderate or extensive changes in the early roentgenograms. No residual abnormalities were detected roentgenographically in any of these cases six months to two years after the fire.

Several typical cases are reported, with roentgenograms showing the various types of lesions encountered.

CLARENCE E. WEAVER, M.D.

**A Study of One Hundred Cases with a Positive Coccidioidin Skin Test.** Dumont Clark and John H. Gilmore. *Ann Int Med* 24: 40-59, January 1946.

Coccidioidin skin tests were done on 372 patients who had spent some time in the Southwestern United States. One hundred and twenty-five reacted positively. Of the positive reactors, 100 in whom pulmonary lesions were demonstrable roentgenographically were chosen for special study. These patients were also skin-tested with tuberculin.

The lung lesions could be classified as coccidioidomycosis in 34 of the selected patients. Nine of these showed *Coccidioides immitis* organisms in the sputum, 15 had a negative tuberculin skin test, and 10 showed *Coccidioides immitis* in the sputum by smear only, or lesions of coccidioidomycosis elsewhere than in the lungs. The pulmonary lesions in the remaining 66 patients who had a positive skin test for both coccidioidin and tuberculin were evaluated in the light of the experience with the known positive cases. Although a definite statement cannot be made, the evidence indicated that the lesions in 36 of these cases were due to coccidioidomycosis.

The organism enters the body through the inhalation of infected dust, or rarely through a skin lesion. The vast majority of infections are mild, self-limited, and involve the lung and associated mediastinal lymph nodes. As resistance to the disease develops, antibodies appear in the blood and the lesion heals. Occasionally fibrosis sets in and a rounded or linear scar remains. In such instances a solid immunity to the disease results. In an exceptional case an abscess may form in the lung or pleura. Rarely the infection enters the blood stream and proves fatal.

From a roentgenographic standpoint, the initial lesion in coccidioidomycosis is a pneumonia-like area of increased density in the lung, of variable size and location. Shortly thereafter, one or both hilar regions usually show evidence of lymph node enlargement, a feature which serves to exclude the superinfection (adult) type of tuberculosis. If the disease does not disseminate, the pneumonia like area will regress in a period of weeks or months. Frequently this initial lesion is confused with so-called atypical or virus pneumonia. As healing takes place, the lesion may disappear or remain unchanged. If not, a rounded nodular dense area or strand like area, which often extends into the hilus, is left. Occasionally the nodular lesions show a central area of lesser density which gives the appearance of a cavity.

There were 4 fatal cases in the authors' series. All showed roentgen findings in the chest suggestive of a diffuse inflammatory process. In all the hilar markings were exaggerated, far more so than in the usual inflammations of pulmonary structures. Autopsies revealed enlarged hilar lymph nodes in each instance. The microscopic examination showed the nodes to be involved by coccidioid granulomata. One patient, just prior to death, presented evidence of a beginning effusion between the right upper and middle lobes. At autopsy a right hydrothorax was present.

STEPHEN N. TAGER, M.D.

**Pulmonary Changes in Carbon Tetrachloride Poisoning.** Charles Moreau Thompson. *Am J Roentgenol* 55: 16-19, January 1946.

Recently a series of 20 cases of carbon tetrachloride poisoning were treated at a Naval Dispensary. Three of the patients were critically ill, and one died. Pulmonary roentgenographic changes were discovered late in the course of events. The changes varied from consolidation of all five lobes to mild increase in lung markings. One case showed a change in the configuration of the cardiac shadow between examinations. Enlarged hilar shadows and peribronchial infiltration were also noted. The amount of change on the roentgenograms of the chest was directly proportional to the severity of the clinical illness. This may be of value as a criterion in individual prognosis. The four more serious cases are described. These presented a toxic nephrotic syndrome with puffiness of soft tissue of the face, hands, and feet. CLARENCE E. WEAVER, M.D.

**Streptococcal Miliary Infiltration of the Lungs, with Description of a Case.** Philip Ellman. *Brit M J* 1: 127-128, Jan. 26, 1946.

A case is reported in which x-ray examination of the chest in a patient with achlorhydric anemia showed diffuse miliary infiltration of the lungs, simulating miliary tuberculosis. The sputum yielded a heavy growth of hemolytic streptococci and the response to penicillin was prompt, the infiltration resolving completely in ten days.

**Calcification of the Left Auricle.** Report of a Case. A. C. Begg. *New Zealand M J* 44: 315-319, December 1945.

Calcification in the walls of the left auricle is a rare observation. The author knows of but a single case, beside his own, in which such calcification was demonstrated during life. An illustration of that case appears in "A Text Book of X-Ray Diagnosis" by British Authors (edited by Shanks, Kerley, and Twining, London, H. K. Lewis & Co.) but no clinical details are given in connection with it except that the patient suffered from mitral stenosis.

The author's patient was a woman of sixty-one, admitted with acute bronchitis and extreme cyanosis. At the age of thirty-one, she had been told that she had a "leaking valve" in her heart and had been advised to live quietly. She continued an active life, however, up to seven years prior to admission, when she first began to experience dyspnea on exertion and some cyanosis. She had had several attacks of unconsciousness, with convulsions, in the past five years and, since the first of these, had been taking digitalis regularly. Examination showed marked cyanosis about the lips, ears, and extremities. The pulse was irregular in rate and

force—about seventy beats a minute. The blood pressure was 190/120. The apex beat was in the seventh interspace, 5 1/2 inches to the left of the midline, and the right border of the heart was 1/2 inch beyond the right edge of the sternum. Numerous systolic and diastolic murmurs were present. The electrocardiogram showed evidence of auricular fibrillation and a tendency toward right axis deviation. The clinical findings suggested the likelihood of stenosis and regurgitation of both the mitral and aortic valves. Although a history of rheumatism could not be elicited, that was thought to be the probable etiologic factor.

On fluoroscopy, the heart shadow was greatly enlarged, both to the right and left. The left auricle with its appendix could be clearly outlined because of the deposits of calcium within its walls. It was greatly enlarged. The inferior surface moved downward on ventricular systole but no intrinsic auricular contraction could be seen. There was definite calcification of the leaves of the mitral valve which could be seen with the characteristic dancing movement. The aortic pulsation was normal. Enlargement of the pulmonary artery shadow was noted.

Radiographic study showed the area of the heart to be about two and one-half times that predicted for a woman of the patient's height and weight. It was estimated that the heart volume was 1,800 c.c. The left ventricle and the right ventricle were both considerably enlarged. The calcium deposits in the left auricle appeared to involve its entire surface, including the appendix and the interauricular septum. The calcification was most marked posteriorly and least marked in the vicinity of the mitral valve and interauricular septum. The capacity of the left auricle was estimated at 250 c.c., compared to a normal of 30 to 45 c.c. The illustrations included with the article are of unusual interest in showing the relationship of the left auricle to the rest of the heart shadow and to the surrounding structures, with particular attention drawn to the deviation of the esophagus and the distortion of the left main bronchus produced by the enlarged left auricle.

Heavy deposits of calcium were present in the mitral valve, the position of which could readily be seen in all projections. Calcification was also present in the region of the aortic valve, but the deposits were lighter and this valve could not be clearly demonstrated fluoroscopically. Exposures of 1/10 second with a Potter-Bucky diaphragm were most satisfactory.

It would appear that the primary lesion in this case was a stenosis of the mitral valve which had led to chronic enlargement of the left auricle and subsequent auricular fibrillation. Satisfactory compensation of the right heart enabled the patient to lead an active life without symptoms of cardiac distress. During this time, calcium was deposited in the walls of the dilated left auricle and in the mitral valve as a degenerative change. As this gradually increased, mitral incompetence increased, with subsequent enlargement of the left ventricle. These gross changes in cardiac dynamics, however, affected the patient very little until the right ventricle began to fail with the additional load of a respiratory infection.

The patient gradually improved and was discharged from the hospital five weeks after admission. She was able to be up and about without dyspnea though she was still somewhat cyanotic.

BERNARD S. KALAVJIAN, M.D.

## THE DIGESTIVE SYSTEM

**Lymphosarcoma, with Primary Manifestations in the Gastrointestinal Tract. Report of Seven Cases Studied Roentgenologically.** Robert D. Moreton. *Texas State J. Med.* 41: 458-464, January 1946.

From a pathologic standpoint, gastro-intestinal lymphosarcoma and carcinoma differ from each other in that the former arises in the lymphoid tissue of the submucosa and infiltrates the mucosa and muscularis, whereas the latter has its origin in the mucosa. Ulceration, when it occurs, is thought by some to be due to necrosis from pressure and loss of blood supply rather than to the malignant invasion itself. Lymphosarcoma may produce an intrinsic, extrinsic, or infiltrating type of lesion. The intrinsic type may manifest itself as single or multiple polypoid growth protruding into the intestinal lumen and producing obstructive symptoms. The infiltrating or intramural type produces an annular lesion which may involve one or more segments of bowel. This type of growth forms, at times, an annular cuff in the involved portion and produces symptoms of incomplete obstruction.

Roentgen findings are not sufficiently characteristic to warrant a specific diagnosis of lymphosarcoma of the gastro-intestinal tract, but it has been suggested that the possibility of gastric lymphosarcoma be considered in all atypical cases showing carcinoma-like deformities. The roentgen findings in the stomach may be negative in the very early stages. In other cases the roentgen report may be gastric ulcer, diffuse infiltration of the entire stomach with or without prominent rugal markings and with or without peristaltic variation, polypoid lesions indistinguishable from carcinoma, or simply an obstructing lesion of undetermined type at the pyloric end of the stomach. In the small bowel, the lower portion of the ileum is the most common site of involvement. Many variations in the roentgen appearance occur. There may be patchy, diffuse, irregular distribution of the barium or a diffuse thickening and contraction deformity as seen in hyperplastic enteritis. Other findings may be those of obstruction, entero-enteral or entero-colic intussusception, or of a simple deficiency state. In the colon, the lesions may be polypoid, there may be filling defects resembling carcinoma, or intussusception of the colocolic type, or rarely diffuse infiltration of the bowel.

Since sarcomas of all types constitute only 3 per cent of malignant growths of the gastro-intestinal tract, to risk a definite diagnosis of gastro-intestinal lymphosarcoma would obviously be somewhat hazardous. Despite this, roentgen examination is indispensable for discovering and localizing the lesion, determining in most instances its neoplastic nature, and permanently recording the original involvement for the determination of its progress or regression at subsequent examinations.

Reports of 7 cases are presented, in which the diagnosis was established either by exploratory operation or removal of enlarged lymph nodes. One patient had lesions in the terminal portion of the ileum and the cecum. In one the stomach and cecum were involved. Two had polypoid lesions in the stomach. A fifth had involvement of the distal portion of the ileum for about 50 cm. A relatively small segment of the ileum and the distal half of the stomach, respectively, were involved in the two remaining cases. An exploratory operation was done in each of the cases and 5 patients.



received postoperative roentgen therapy. There were five deaths in the series. Two patients, with involvement of the stomach, showed no evidence of recurrence when last seen, thirty-four and thirty-six months after their first admission. One of these patients had been treated by resection and postoperative irradiation, the other by irradiation alone.

The author suggests that the term "tumefactive lesion" rather than carcinoma should be used in radiologic and gross pathologic diagnosis of gastro-intestinal neoplasms, since it carries no etiologic or histologic implication.

BERNARD S. KALAYJIAN, M.D.

**Gastric Carcinoma. Review of Errors in Diagnosis.** Meyer Golob. *Am J Digest Dis* 13 17-23, January 1948.

The author lists four factors which enter largely into the wrong interpretation of symptoms and lead to delay in the diagnosis of gastric cancer: (1) age incidence, (2) length of history, (3) size or site of lesion, (4) malignant degeneration of a benign ulcer. Neither the age of the patient, the size of the lesion, nor the presence of hyperchlorhydria or achlorhydria should lessen the suspicion of gastric cancer. Nor should dependence be placed on a therapeutic test, since practically every case shows relief of symptoms when clinically treated.

To illustrate the fallacy of ruling out cancer because the patient is "too young," a case is recorded in a man of 37 with a history of gastric symptoms for eight years. He was first seen by the author in January 1936, with complaints dating back two years—loss of weight, anorexia, and hypochlorhydria progressing to achylia. Roentgen examination in December 1934 had shown an irregular antrum and bulb which were thought to be due to an old ulcer. Exploration was recommended, but the patient improved on a medical regime, and operation was postponed until January 1936, when an anaplastic grade IV carcinoma was found, with metastases in the regional lymph nodes.

Two cases are presented to show that a short history does not necessarily rule out cancer. The first patient, a 64-year-old man, showed the textbook picture of malignant neoplasm, though earlier roentgen examination in a commercial laboratory had been reported negative. The second patient, a man of 45, had symptoms of three months' duration, mimicking duodenal ulcer. At operation a huge ulcerating cancer of the stomach was found.

The gastric chemistry may also be misleading, as shown by a case in a patient of 31 with symptoms of seven months' duration but no abnormal chemical findings. Roentgen examination showed a slightly deformed duodenal cap and a serrated defect on the greater curvature. The case was diagnosed as duodenal ulcer and a Sippy diet was given for a year. Roentgen examination at the end of that time revealed the same defect, and laparotomy showed advanced cancer.

In another case, in a neurotic woman of 52, with a long history of gastric disturbances and a positive test for occult blood in the gastric contents, an unusually small defect on the lesser curvature was ignored for more than a year, during which the patient was treated for gastritis. At operation a far advanced carcinoma was found.

That misleading roentgen findings may obscure the transitional phase of a benign gastric ulcer into a malignant

neoplasm is shown by the case of a man aged 55 who had a gastric ulcer for twenty years. Repeated roentgen examinations showed the ulcer to have become smaller. The patient died from hemorrhage, and autopsy showed a malignant ulcer with metastasis. In discussing this case the author quotes Alvarez as stating that, "the only way in which one can hope to cure cancer of the stomach is to excise it during the stage in which it looks and behaves like a benign ulcer." A lesion of the stomach which is apparently healing, as shown by roentgen examinations, may actually be malignant and infiltration of tissue at the base of the defect may occur while the cancer is spreading and give the impression that the niche is filling up.

JOSEPH T. DANZER, M.D.

**Diverticula of the Stomach.** W. R. Moses. *Arch Surg* 52 59-65, January 1946.

Diverticulosis of the stomach is an uncommon lesion, generally found on the posterior wall near the lesser curvature in the cardia. It is frequently without symptoms, and when present, these are not characteristic. In about 30 per cent of the cases other gastroduodenal disease coexists and produces symptoms, and in about a third the symptoms are due to the diverticulum itself.

Diverticula may be classified as true (congenital) and false (acquired). The latter may be further divided into traction and pulsion types.

The roentgenologic differentiation of a diverticulum from a penetrating ulcer is based on the following points. In ulcer there is a tendency to spasm near and opposite the lesion and infiltration or rigidity of the mucosal border is present. In differentiating from diaphragmatic hernia, it is helpful to note that diverticula are larger on expiration, herniae on inspiration. The presence of an intrathoracic shadow and the constriction of the neck at the passage through the diaphragm are also indicative of hernia. Gastroscopic examination is an important aid, but the diagnosis may easily be missed by any method. If treatment is indicated to control symptoms, surgery is probably the method of choice.

A case, in which rupture of a gastric diverticulum led to intraperitoneal hemorrhage, diagnosed at operation, is reported. This complication has not previously been recorded.

LEWIS G. JACOBS, M.D.

**Diverticula of the Colon versus Gallstones.** Arnold Galambos and Wilma Mittelman-Galambos. *Am J Digest Dis* 13 14-16, January 1946.

A case of diverticulosis is presented in which the diverticula were confined to so circumscribed an area around the hepatic flexure that roentgenologically they were at first mistaken for gallstones. They even appeared to be faceted, while some had a dense cortex suggestive of calcium-containing calculi. It was later found that the resemblance to stones was due to residual barium following a barium enema study. The diverticula had not filled at the time of the enema, nor were they shown on a film made after evacuation. They were seen, however, during cholecystographic study, when a non-functioning gallbladder was demonstrated. A subsequent film showed some of the pseudo-stones to have become smaller and others to have disappeared and this led to the correct interpretation.

JOSEPH T. DANZER, M.D.

**Appendicitis with a Massive Peristaltic Movement of the Colon.** (Case Examined by Barium Meal and by Enema.) J A Mathiez J de radiol et d'électrol 26 364-368, 1944-45

A girl of twenty-five came under observation because of chronic abdominal distress and was examined by barium meal and enema. She evidently had chronic appendiceal involvement and exhibited tenderness over the cecum. When the examiner was palpating that area, the right half of the colon contracted. This occurred several times and, though more barium was admitted, the cecum tended to remain empty.

The author discusses this phenomenon academically, quoting some of the earlier German roentgenologists who spent a great deal of time in deciding by what sort of movement the large intestine emptied itself. He concludes that the patient's having appendicitis probably had something to do with the "grand mouvement" upon which he dwells at such length, which is tantamount to an admission of entire unawareness of the modern approaches to gastroenterology. The cecum may, of course, be irritable in appendicitis, and in regional enteritis, too, and in carcinoma of the cecum.

PERCY J DELANO, M D

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The authors report a case of retroperitoneal hernia containing a giant Meckel's diverticulum, associated with recurrent bouts of intestinal obstruction. The diagnosis was suggested from the radiographic finding of an air and fluid level in a dilated loop of gut in the right upper quadrant. A small intestinal study revealed the gas-filled loop to be distal ileum, while lack of mobility on manipulation and positioning strongly suggested that the loop was enclosed in a membrane or sac. These findings were confirmed at operation. Only a limited portion of the ileum was involved, and the hernial sac was avascular, with no large vessels either at the entrance or exit. Following complete resection and anastomosis the patient made a good recovery, with relief of all symptoms. Roentgenograms and photographs are included.

ELLWOOD W GODFREY, M D

**Cholecystography for Children.** Victor E Hrdlicka, Carlton G Watkins, and John A Robb. Am J Dis Child 70 325-328, November-December 1945

Cholecystography with Priodax was carried out in 47 unselected infants and children. The medium was found to be satisfactory for those over nine months of age. Under that age the percentage of successful results was low. The recommended dose of 0.5 gm per 10 kg of body weight proved adequate for children over four years, but larger dosage—as much as 1.5 gm per 10 kg—was sometimes necessary for younger children and infants. Toxic effects were minimal, even in very young infants given two or three times the ordinary dosage of Priodax.

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A case of double gallbladder, presumably with separate cystic ducts, is reported. The diagnosis was established by cholecystography.

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The author prefaces the presentation of a case of calcified cyst of the spleen, demonstrated roentgenographically, with a brief description of calcifications in that organ and a classification of splenic cysts.

## THE MUSCULOSKELETAL SYSTEM

**Normal Development of the Ossific Centres During Infancy and Childhood.** A Clinical, Roentgenologic, and Statistical Study. Olle Elgenmark. Acta paediat. 33, Supplementum I, pp 1-79, 1946

In previous studies of the development of ossification centers the practice has generally been to determine their differentiation from observations made on bone development in one area of ossification, usually the hand or the hand and foot. In the present investigation, the author shows that there is no absolute correlation between the appearance of the different ossific centers and that it is consequently not possible to draw hard and fast conclusions concerning other centers on the basis of the differentiation present in a few isolated areas. Not even in the two halves of the body do the corresponding centers make their appearance quite uniformly.

In this study a number of simultaneous observations were made of the dates of appearance of the centers in several readily accessible ossification areas, i.e., the skeleton of both extremities on the right side of the body, comprising 68 ossific centers, and in a few subjects, for purposes of comparison, the corresponding parts of the skeleton on the left side also. Five years was taken as the upper age limit, because only a few centers appear later in these areas. A total of 1,190 observations were made on 852 carefully selected children, and the material was then studied statistically.

The investigation brought out the fact that there is great variation in the times of appearance of the individual ossific centers and also that there is a considerable difference between the sexes, the centers of girls differentiating much earlier than those of boys. Appropriate calculations proved that there are significant and positive correlations of equal degree between the differentiation of the ossific centers and age, height, and weight. By means of partial correlations between age and height and ossific centers, it was established that in infancy the height shows a stronger correlation with ossific center development than age; later on, the correlation is largely equal.

Tables for the development of ossification centers are presented.

**A Study of the Development of Rickets in Premature Infants.** Gert v Sydow. Acta paediat. 33, Supplementum II, pp 1-122, 1946

All premature infants with a birth weight not above 2,000 gm. born at the Sahlgren Hospital, Göteborg, during a two and one half year period, whose condition permitted were examined at regular intervals, with blood analyses and roentgenograms of the wrist. To obtain normal values for the blood chemistry as a control, two groups of normal full term breast-fed infants

were also studied. The following facts were established by this investigation.

Premature infants receiving only human milk without any supplement in the first days of life have about the same serum inorganic phosphorus values as normal, higher serum phosphatase, and lower serum calcium and serum protein values. In the following months, the serum phosphatase increases, and the serum inorganic phosphorus and serum calcium decrease considerably.

Premature infants fed human milk and vitamin D show significantly higher serum calcium than those not receiving vitamin D. Infants given cow's milk but no vitamin D showed significantly lower values for serum phosphatase and higher for serum inorganic phosphorus than those receiving human milk exclusively. Those given cow's milk and vitamin D showed significantly lower values for serum phosphatase and higher for serum inorganic phosphorus and serum calcium than those given only human milk. Supplies of different mineral preparations may act to a certain extent in the same manner as cow's milk. Seasonal variations in the serum values have been established for the normal groups and for premature infants receiving human milk with or without vitamin D.

Roentgen signs of rickets appear in more than half the infants after the first month of life, before the age of one month, they appear occasionally. Metaphyseal decalcification, which may possibly be regarded as an early rachitic or prerachitic sign, usually appears before the age of one month. Except for metaphyseal decalcification, "fringing" and "cortical spurs" seem to be the earliest signs of rickets in premature infants, usually appearing in the first half of the second month. At the appearance of fringing, serum phosphatase is possibly somewhat higher and serum inorganic phosphorus somewhat lower than the average for premature infants. At the appearance of spurs, serum phosphatase is possibly higher than the average, but serum inorganic phosphorus seems to be average.

"Cupping," "spreading," and "periosteal encasements" of the shaft were not very often recorded and were coincident with or even subsequent to calcification at the epiphyseal line. Therefore, in this series, they may be regarded as fairly late signs of rickets.

Calcification at the epiphyseal line was always one of the latest signs of rickets to appear. The serum values at its appearance are not more normal, however, than the mean for the age group, and it may then be regarded as a sign of healing but not of health.

When roentgen signs of rickets are present in premature infants fed human milk with or without vitamin D, the serum phosphatase is much higher and the serum inorganic phosphorus lower than when the roentgen picture is normal. In premature infants fed cow's milk there is no difference in these respects. In those not receiving vitamin D, the serum calcium is much lower when roentgen signs of rickets are present, but when vitamin D is given, serum calcium is the same in infants with rickets and in those with normal roentgen findings.

The author concludes that human milk may not supply the premature infant with a sufficient amount of phosphorus, though it gives a fairly sufficient amount of calcium. The latter, however, will not be absorbed in sufficient amounts unless vitamin D also is given. When cow's milk is supplied, a sufficient amount of phosphorus is absorbed, but not of calcium unless vitamin D is given. Rickets in the first months of life in premature infants is most frequently due to an in-

sufficient supply of phosphorus or an insufficient absorption of calcium, but these may not be the only causes.

**Rickets and Infantile Scurvy Occurring in a Case of Osteogenesis Imperfecta** Ralph S Bromer *Am J Roentgenol* 55 30-36, January 1946

Affections of the skeleton may occur simultaneously in children. The author reports the case of a male Negro infant showing evidence of osteogenesis imperfecta, with pathological fractures, in whom rickets developed at the age of three months and infantile scurvy at twenty-one months. The unusual feature of the case was that, though the osteogenesis imperfecta was apparently present from birth, the roentgen changes in the skeleton were characteristic of the late type of the disease rather than the congenital. The case is described in detail and roentgenograms are reproduced showing the typical bone changes of the three diseases.

CLARENCE E. WEAVER, M.D.

**Congenital Malformations of the First Thoracic Rib. A Cause of Brachial Neuralgia Which Simulates the Cervical Rib Syndrome** James C. White, M.H. Poppel, and Ralph Adams *Surg., Gynec. & Obst.* 81 643-659, December 1945

The authors have observed 10 cases of abnormalities of the first thoracic rib, 5 of which were asymptomatic and 5 of which presented a cervical rib syndrome. The case histories of the latter group are given in detail, and roentgenograms of patients from both groups are reproduced. The literature is reviewed.

The abnormal rib is generally a rudimentary structure terminating in a synostosis or pseudoarthrosis with the second rib near the scalene tubercle, or in a free end in the soft tissues at the base of the neck, which may be connected by a ligamentous band with the manubrium sterni.

From a review of comparative anatomical studies and embryological theories, the authors conclude that these malformations are best explained by errors of body segmentation in early embryonic development and are often brought about by abnormal formation of the brachial plexus and blood vessels. The symptoms and clinical evidence consist of supraclavicular bony prominence, irritation or paralysis of the brachial plexus, and compression of the subclavian vessels as they cross the defective rib.

On the basis of symptoms and physical signs the authors cannot differentiate first rib abnormalities from cervical rib or from compression by the anterior scalene muscle. Even roentgen studies require special care if a correct diagnosis is to be made. It is essential to be able to outline all the vertebrae in the neck and upper thorax on an anteroposterior film which shows the details of the upper rib articulations as well. This can be accomplished by making a long exposure with the patient opening and closing his mouth. In this way the shadow of the mandible is blurred so that it does not obscure the outlines of the atlas and axis. Anteroposterior x-ray films should include the whole of the second as well as the first rib, as the anomaly often involves the two. All of the bony structures bounding the thoracic apex require careful scrutiny. In unusual cases it may be advisable to include the entire spine, so that the total number of ribs and lumbar vertebrae can be counted. Unless these precautions are observed, first rib deformities may be missed.

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recognized two types of the disorder, the creeping perostotic and the diffuse osteitic type. Some patients have severe headaches and various visual or auditory disturbances. Exophthalmos is frequently present. Insomnia, mental dullness, and convulsions may develop. The course is variable (from twenty to forty years). The diagnosis is usually made by roentgen examination of the skull, which reveals diffuse hyperostosis of the bones of the face (notably the malar, frontal, and sphenoid bones). The hyperostosis is usually uniform and "osteomatous." Inflammatory osteitis, Paget's disease, and acromegaly are to be differentiated.

A case of generalized leontiasis ossea in a male aged thirty years is reported. Both types of the disease were present in this patient. The cranial bones and mandible showed typical diffuse "osteitic" overgrowth, the long bones of the extremities showed diffuse symmetrical cortical and periosteal overgrowth.

CLARENCE E. WEAVER, M D

#### Mutational Dysostosis (Cleidocranial Dysostosis)

A B Soule, Jr. J Bone & Joint Surg 28 81-102, January 1946

Mutational dysostosis is frequently transmitted from parents to offspring and is characterized by multiple variable developmental skeletal anomalies, usually aplasia of the clavicles, delay in closure of the fontanelles and sutures, brachycephaly, prognathism, irregularity in dentition, and structural abnormalities of the other bones. The skull may show increased transverse and decreased anteroposterior diameters. Some of the bones are underdeveloped. The facial bones are poorly developed and asymmetrical. The teeth will show abnormalities when dentition occurs. Some may be absent or there may be supernumerary teeth.

The clavicles are most commonly abnormal. They may show small defects or be completely absent. The scapulae are small and primitive. Anomalies of the humerus, radius, and ulna are uncommon but do occur.

The spine may show curvatures, fusion defects, and maldevelopment of vertebrae. The pelvic bones are small and primitive in appearance. There may be failure of bones to fuse. The femoral neck may be deformed or absent, otherwise the femora, tibiae, and fibulae are usually normal.

There is a striking resemblance between all these patients in appearance. They are usually in good health and often are led to consult a physician because of the dental abnormalities.

Six cases are presented, with reproductions of radiographs which show various abnormalities.

JOHN B. MCANENY, M D

#### Hemiatrophy of the Body in Adult Life

Norman Reider and Glen S. Player. J Nerv & Ment Dis 103 1-8, January 1946

The causes of hemiatrophy of the body are numerous, including birth injuries, head trauma in childhood or adult life, encephalitis of various types, vascular lesions, and tumors. None of these factors, however, seems to have been present in the two cases recorded here. In such idiopathic cases, pneumoencephalography offers a means of definite diagnosis.

The authors' two patients were soldiers 22 and 24 years of age. The first had been in excellent health throughout a long combat experience. He was hospital-

ized for trench foot, and during a routine examination it was noted that the right arm and leg seemed smaller than the left. On questioning, it was learned that there had been a "little tiring" of the right leg during the past three months. The atrophy continued to increase for a month, after which progress ceased. There was a difference of 2 inches in the circumference of the calves, and of 1 1/2 inches in the circumference of the biceps. There was no change in motor power, sensation, co-ordination, or reflexes. A pneumoencephalogram made six months after onset showed slight bilateral internal hydrocephalus, with the left lateral ventricle larger than the right.

The second patient complained of headaches on walking, dull pain, and stiffness of the right leg. A slight difference in the size of the extremities seems to have been noticed previously but received no special attention. Four months later the headaches were worse and the right leg was painful. Four months after this, the patient was thrown from a jeep, following which he had transient diplopia and weakness of the right arm. A difference of 7/8 inch was found between the right and left calves, the reflexes of the right arm were slightly more active than those on the left, and there was a transient right ankle clonus. Further examination showed the face, trunk, and extremities all to be involved in the hemiatrophic process. A pneumoencephalogram revealed dilatation of the left lateral ventricle, especially in its middle portion.

In each of these cases a spinal origin of the muscular atrophy was suspected, but a cerebral origin was established by the encephalogram. The authors believe that the more common phenomenon of facial hemiatrophy would frequently be shown to be cerebral in origin if the possibility were kept in mind and encephalography were done in all cases. They feel that it is possible, also, that the rare atrophies of an extremity attributed to subclinical poliomyelitis may be of cerebral origin.

BERNARD S. KALAYJIAN, M D

#### Osteogenic Sarcoma. II Roentgenographic Interpretation of Growth Patterns in Bone Sarcoma.

Ian MacDonald and John W. Budd. Surg, Gynec & Obst 82 81-86, January 1946

The roentgen-ray study of bone tumors, according to the authors, should be interpreted as a reflection of their growth characteristics rather than an indication of tumor types, a kinetic rather than a static concept. The roentgenographic features of a bone tumor at any given time are dependent upon the balance between neoplastic activity (osteolysis) and the degree of cortical or medullary reaction (sclerosis) as well as the absence or extent of ossification and calcification.

The observations presented here were made by careful study of 118 cured cases of bone sarcoma (previously reviewed in Surg, Gynec & Obst 77 413, 1943; Abst in Radiology 42 524, 1944) and a smaller number of uncured cases from the Registry of Bone Sarcoma of the American College of Surgeons. The expression, "osteogenic sarcoma" is used in this article as a generic term for all sarcomas originating in the connective tissue of bone, including osteosarcoma, chondrosarcoma, and fibrosarcoma.

From this study the authors conclude that the experienced roentgenologist can differentiate between benign and malignant tumors with almost complete accuracy through an interpretation of their growth patterns. A diagnosis of osteogenic sarcoma can be

As to treatment, a trial of conservative measures is recommended. If these are unsuccessful, then exploration and transection of the anterior scalene muscle may be done plus (unless the rib is quite rudimentary) excision of the rib from the clavicle to where the bone disappears in the posterior muscles of the neck.

This is an informative article but it should be noted that it deals with an obviously selected group of patients. The percentage of symptomatic cases would be much lower with a more comprehensive method of selection.

FREDERICK A. BAVENDAM, M.D.

**A Contribution to the Radiologic Study of the Deficiency Osteopathies. Syndrome of Milkman-Debray-Looser.** F. Lepennetier, E. Gilbrin, M. Godefroy, and R. Tricot. *J. de radiol. et d'électrol.* 26: 197-209, 1944-45.

The authors describe in great detail a case of the so-called syndrome of Milkman-Debray-Looser, "remarkable for the multiplicity of the bone changes," and make this the occasion for a general discussion of the disease.

As to the lesion itself, little is added to that which has already been written, for, under one title or another, the roentgen appearance has been fully described by various writers over a period of some years. Briefly, it consists in a line of decreased density, occurring more often in long bones but also in flat ones, and with no definite site to which its occurrence can be said to be restricted. In the long bones the line is transverse. From the beginning [and since the first comprehensive description was by Looser, whose name the lesion bore for years, it seems a bit out of keeping that the authors should have contrived a title in which his name forms the last link] the condition has been considered to be of nutritional origin. The variant described by Milkman bore, as part of its title, the word "fracture." One of his publications (*Am. J. Roentgenol.* 32: 622, 1934) is headed "Multiple, Symmetrical, Spontaneous Fractures," and this entity became known in America as "Milkman's disease."

After march fracture involving a metatarsal became better understood and passed from the category of idiopathic diseases (Deutschländer's disease, etc.), other sites of similar fracture began to be described: the tibia, neck of the femur, even the pelvis. The similarity of the fracture line seen in these instances with those of the original Looser *Umboosenen* finally began to be generally appreciated, and gradually the concept of this bony phenomenon is becoming clarified.

The present paper is profusely illustrated, early and late stages of the fracture lines are shown. The history of such injury is, however, as nebulous as traditionally postulated. The description of the lesions is rather redundant. Milkman's modest contribution receives somewhat more stress than would appear indicated. The German contributions have consistently been the closest to pointing out the true state of affairs, with their frequent emphasis on the coincident nutritional state of the individual. [Only in metatarsal march fracture can the constitutional state be set aside, here the predisposing factor is a purely local one—the "weak foot" as originally described by Morton.]

One tries, from time to time, to gather together the rapidly accumulating terms descriptive of a basic pathologic entity, but it is difficult to keep abreast of them. For march fracture, strain fracture, Looser's zones, *Umboosenen*, transformation zones, acute trans-

verse atrophy of bone, fatigue fracture, multiple idiopathic symmetrical fractures, etc., the term "hunger osteopathy," which was apparently first employed by the German writers, might well be substituted.

PERCY J. DELANO, M.D.

**Chronic Sclerosing Osteitis.** Henry W. Meyerding. *Western J. Surg.* 53: 413-420, December 1945.

The term "chronic sclerosing osteitis" is used to designate those cases of low grade infection which produce a marked thickening of the bone localized to a single segment. The author's series of 80 cases represents about 2 per cent of all the cases of osteomyelitis seen at the Mayo Clinic in thirty-two years, from 1912 to 1943. Thirty of the number were previously reported by Henderson (*J. A. M. A.* 82: 945, 1924).

The outstanding symptom of chronic sclerosing osteitis is persistent pain of varying severity, which may be present for months to years. This pain, as a rule, is worse at night, it usually remains localized, and is deep seated, along the shaft of the long bones. The average duration of the cases in this series was 14 years. Trauma, exposure, and debilitating disease aggravate the pain. The blood findings are usually not of great help, since the white count is commonly normal and the concentration of hemoglobin and the red count are frequently within normal limits. Flocculation tests are negative. The most significant findings are those revealed by radiography. The exact site and size of the lesion can be easily determined. The radiographic appearance is that of a dense sclerotic area in the shaft of the long bone involving the cortex and the spongy bone. There is often a central area of decreased density which is considered the nidus of the infection. The cortex may be involved on one side only, or the involvement may go completely around the cortex and produce considerable enlargement.

The author goes into detail as to the differential diagnosis of this lesion from syphilis, osteogenic sarcoma, osteitis deformans, traumatic ossifying hematoma, Ewing's sarcoma and metastasis from prostatic carcinoma. Since the details of such a differential diagnosis are well known to most radiologists, they are not included in this review.

The treatment of chronic sclerosing osteitis is surgical, the extent of the operation depending on the degree of involvement present. The author advises saucerization of the involved bone with removal of as much of the infected bone as possible rather than simply drilling the bone. The average age of the patients is twenty-five years, and the end results of the operative procedure are usually quite good. The author states that about 70 per cent of the patients had complete relief of their symptoms and about 15 per cent had partial relief.

BERNARD S. KALAJIAN, M.D.

**Generalized Leontiasis Ossea.** L. H. Garland. *Am. J. Roentgenol.* 55: 37-43, January 1946.

Leontiasis ossea is an uncommon disease. The hyperostosis may be limited to one bone of the skull or involve all of them. In the latter event, the bones of the face may be enlarged and distorted but the facies is almost never leonine. Occasionally there is involvement of the long bones. The disease begins in childhood or adolescence, and females are said to be more commonly afflicted than males. The cause is unknown. Grossly, Knaggs (*Inflammatory and Toxic Diseases of Bone*, New York: William Wood & Co., 1926).

**Backache.** Henry W Meyerding and Forrest L Flashman J A M A 130 75-78, Jan 12, 1946

Attention is called to a fairly common spinal lesion responsible for low back pain, namely, a defect in the pars interarticularis or isthmus of the vertebra which is known as prespondylolisthesis, spondylolysis, rachischisis, and spondyloschisis. Trauma is considered the precipitating factor, with a congenital lesion as the predisposing factor.

Patients complain of backache of several years' duration with aggravation in direct proportion to the amount of strain placed on the back. Examination may or may not elicit pertinent signs. The diagnosis depends on a careful history and roentgen examination. The importance of the oblique projection for demonstration of the defect is emphasized.

Treatment is directed toward increasing the stability of the lower spine. The majority of patients have been treated conservatively, by back supports, rest, sleeping on a firm bed, application of heat and massage to the back, and exercises to strengthen the muscles of the back. Those who did not respond to conservative treatment have improved following spinal fusion.

Reproductions of roentgenograms and reports of seven cases are included.

H D WELSH, M D  
(University of Michigan)

**Pyogenic Osteomyelitis of the Spine.** Differential Diagnosis Through Clinical and Roentgenographic Observations. Jose Puig Guri J Bone & Joint Surg 28 29-39, January 1946

This study is based on 48 cases of osteomyelitis of the vertebral body or arch, which are divided as to location and nature of the infection.

The *hip-joint syndrome* presents a septic reaction with hip joint pain, but there is no pain on palpation of the posterior aspect of the articulation nor on percussion of the trochanter. Motion is limited only in extension. Tenderness is confined to a region of the spine, with limitation of motion of the spine especially in flexion and spinal pain on any attempt to extend the leg.

In the *abdominal syndrome*, the symptoms are suggestive of intra-abdominal disease, but in the presence of a vertebral lesion contraction of the abdominal muscles during palpation causes no change in the pain or tenderness, while in abdominal disease the pain practically disappears. One case in the author's series presented this syndrome.

The *meningeal syndrome* shows clinical signs of meningeal irritation. The onset may be acute or insidious. Three such cases were seen.

The *back-pain syndrome* may be acute, subacute, or insidious. In the acute form (16 cases) there is sudden back pain, severe, constant, and usually interfering with sleep. There is a marked systemic reaction. Blood culture may be positive. An abscess may form after one to three weeks. The subacute form (7 cases) shows a mild toxemia, often following a septic infection elsewhere in the body. Epidural abscess may form, with a flaccid paralysis of the lower extremities, temperature elevation, and difficulty in voiding. With an insidious onset, there is no general systemic reaction, the sharp pain is not relieved by rest, but, in fact, is worse at night and upon sneezing and coughing. There is localized tenderness and limitation of motion.

Roentgenographically there is no distinctive feature of pyogenic osteomyelitis of the spine. The localized form showed a small circumscribed area of destruction near the epiphyseal ring or cartilaginous plate. Narrow-

ing of the intervertebral space and atrophy of the bone occur early. After four to six months, sclerosis appears. Healing takes place in nine to twelve months.

It is only by careful study of films taken at intervals over a long period of time that the difference between pyogenic and tuberculous osteomyelitis will become evident. In the tuberculous type the duration is much longer—two to three years as compared to nine to twelve months. The intervertebral space is narrowed in pyogenic infection but not to the same degree as in tuberculosis. New bone formation is seen in one to three months in pyogenic infection, but much later, if ever, in tuberculosis. Sclerosis develops early about a pyogenic infection but is absent or very mild in an early tuberculous infection.

In the diffuse form, lessening of density and fuzziness of outline occur early and at about three months are followed by sclerosis that lasts for three to six months. In tuberculous spondylitis, the atrophy lasts for at least two years and is rarely replaced by sclerosis. Reactive new bone formation is rare and late in tuberculosis but early and constant in pyogenic infection.

Very infrequently bone sclerosis is seen in tuberculosis but is certainly rare and usually only defined in radiographs of the pathological specimens. Sclerosis in pyogenic spondylitis is clearly seen and is a differential feature. Spondylitis characterized by marked sclerosis and bone formation should be suspected of being chronic staphylococcal osteomyelitis.

JOHN B McANENY, M D

**Fracture of the Medial Epicondyle with Displacement into the Elbow Joint.** James Patrick J Bone & Joint Surg 28 143-147, January 1946

Fracture of the medial epicondyle with displacement into the elbow joint usually occurs between the ages of 10 and 17, and is often associated with injury to the ulnar nerve. It may result from a fall on the hand with abduction of the forearm on the humerus or it may follow a posterolateral dislocation of the elbow. Diagnosis is usually made by x-ray, although the patient cannot always extend the elbow, and the displaced epicondyle may be overlooked. Ulnar nerve paralysis suggests injury to the medial epicondyle and its location should be determined. Reduction may be effected by abduction of the forearm with supination and extension of the wrist and fingers, which pulls the epicondyle from the joint space.

In studying this problem the author finds that, if in a lateral view of the elbow the epicondyle can be seen at the level of the joint, it may be considered to be in the joint. A strong faradic current applied to the flexor muscles with the wrist held in extension may pull the displaced epicondyle from the joint space.

In old cases, it is often impossible to move the epicondyle. Operative removal has been rather unsatisfactory, because the rough surface of the epicondyle erodes the coronoid process and initiates an arthritic process, which is not corrected by removal of the fragment. The author believes it better not to operate on these patients, since some cases will clear up in time and in any event little good can be done surgically.

Ulnar nerve paralysis usually clears up if given enough time. Sometimes a constricting fibrous band must be removed. Anterior transplantation of the ulnar nerve may be necessary where a cubitus valgus deformity is present, which stretches the nerve.

JOHN B McANENY, M D

made with reasonable certainty if there is evidence of a cortical malignant tumor, though further differentiation into tumor types by radiographic methods is highly unreliable.

The salient features of the three connective-tissue sarcomas, as noted in the reviewed material, are presented and illustrated in the form of a diagram. The prognostic importance of differentiating osteogenic sarcoma as to tumor type is stressed, since osteosarcoma is almost uniformly fatal, while fibrosarcoma is much less malignant, with chondrosarcoma occupying a median position. That metastatic carcinoma may simulate perfectly the appearance of primary sarcoma of bone is illustrated by a case of metastatic adenocarcinoma from the prostate gland which was diagnosed by three roentgenologists as "typical osteosarcoma." Microscopic study of open biopsy material, therefore, remains the most essential single diagnostic method in bone tumors and should precede the institution of any therapeutic program. The only notable exception is Ewing's sarcoma, in which a therapeutic test with small doses of  $\gamma$  radiation is of definite diagnostic value.

JOHN H. FREED, M.D.

**Sarcoma Complicating Paget's Disease of Bone**  
Thomas J. Summey and C. Lowry Pressly. *Ann Surg* 123: 135-153, January 1946.

Three illustrative cases of sarcoma complicating Paget's disease are reported. The authors state that there seems to be a definite relationship between osteitis deformans and sarcomatous change. Coley and Sharp (*Arch Surg* 23: 918, 1931) stated that in patients with Paget's disease and sarcoma of bone the tumor is invariably in parts of the skeleton showing osteitic changes. von Albertini (*Virchows Arch f path Anat* 268: 259, 1928) described a "presarcomatous change" in the bone marrow of multiple bones in long standing cases of Paget's disease, and Speed (see Hansen. *Tr West S A* (1941) 51: 59, 1942) suggested that the osteoid tissue of Paget's disease has a lesser chronological age than normal bone and is therefore more subject to malignant change.

The prognosis in sarcoma complicating Paget's disease is extremely grave, as the life expectancy is less by ten months than in uncomplicated osteogenic sarcoma in the same age group. Unlike uncomplicated osteogenic sarcoma, the sarcoma of Paget's disease often involves multiple bones. There is no known cure.

The authors have reviewed the literature and have tabulated all the cases of sarcoma in Paget's disease which they were able to find—a total of 76, including their own. A full bibliography is appended.

ELLWOOD W. GODFREY, M.D.

**Osteochondromata of the Pelvic Bones**  
Ralph K. Ghormley, Henry W. Meyerding, Robert D. Mussey, Jr., and Clarence A. Luckey. *J Bone & Joint Surg* 28: 40-48, January 1946.

Osteomata and osteochondromata of the pelvic bones are usually considered to be benign growths, but they may become malignant. Some, but not all, are accessible to surgical removal. Complete eradication can be determined only by microscopic examination. The patient usually seeks relief for pain, swelling, or deformity caused by the tumor. About 10 per cent of these lesions can be expected to recur after removal.

In the authors' series of 40 patients with osteochondromata of the innominate bone, 26 were males and 14

females, and the age range was four to sixty-two years. Three patients with multiple congenital exostoses are included. The duration of symptoms varied from one week to twenty-one years, in 3 cases the tumor was found incidentally.

Sixty-nine surgical procedures were carried out on 40 patients, one patient being operated upon 12 times. Eleven patients received postoperative irradiation, but no definite evidence of benefit from the irradiation could be determined.

Nine, or 22.5 per cent, of the 40 patients are known to be dead. Eight, or 20 per cent, were living with recurrences at the time of the report. Recurrence is not, however, an absolute indication of malignancy. Four cases proved to be malignant. No evidence of mutation was found, but sections from one part of the tumor may be benign while other sections are malignant.

JOHN B. McALEEN, M.D.

**Eosinophilic Granuloma of Bone** Report of a Case.  
J. O. Mercer. *New Zealand M J* 44: 320-322, December 1945.

Eosinophilic granuloma is a variant of the presumably infective diseases of the reticulo-endothelial system, of which Hand-Schüller-Christian disease, infective reticulo-endotheliosis, and Letterer-Siwe's disease are more familiar examples. The majority of these conditions are rapidly fatal. One group, however, usually shows little systemic disturbance and the lesions resolve after curetting, radiotherapy, or even spontaneously. These latter cases were first described as solitary granuloma of bone but more recently, since they have been found to be multiple in some instances and carry a characteristic histologic picture, have been more accurately termed eosinophilic granuloma of bone. This disease closely simulates malignant diseases of bone, particularly myeloma, both clinically and in microscopic appearance. Because of the vast differences in prognosis, it is important to distinguish the two.

The patient described in this report was a girl first seen at the age of nineteen months with a fluctuant bluish swelling immediately behind the anterior fontanelle, near the vertex of the skull. Radiologic examination showed a circular punched-out defect in the upper part of the right parietal bone. Three months later, the defect had enlarged to some extent and measured  $1\frac{1}{4} \times 1\frac{1}{2}$  inches. One year after the first observation, signs of acute mastoiditis developed. At operation, the bone of the mastoid area was found to be soft, and a considerable portion of the middle ear was filled with what appeared to be a vascular tumor. A section was taken but no definite diagnosis was obtained. After showing satisfactory healing, the mastoid scar broke down in about six weeks, and it was again necessary to explore the area. At this time, extensive bone destruction was found, and the antrum and middle ear were full of new growth. Microscopic examination suggested chronic osteomyelitis or eosinophilic granuloma of bone. The child made rapid progress following this exploration and any further surgical intervention was considered unwarranted. Two years later, the parietal tumor was found to be slowly resolving, and a radiograph of the skull showed reduction in the size of the bony defect. As far as can be determined from the report, no radiation therapy was given and healing of the parietal lesion was spontaneous.

BERNARD S. KALAYJIAN, M.D.



**Double Uterus and Double Vagina. Identical Doubles Demonstrated by Colpohysterosalpingography** R R Killinger and H B McEuen *Am J Obst & Gynec* 51 121-124, January 1946

The authors advocate a simple and uniform nomenclature for describing abnormalities of the female genital tract due to lack of fusion of the müllerian ducts and/or irregularities of canalization. Such a classification has been published by Taylor (*Am J Obst & Gynec* 46 388, 1943) and is as follows: (1) uterus arcuatus, (2) double uterus with a single cervix, (3) septate uterus with a single or septate vagina, (4) double uterus with a double cervix, (5) uterus with a rudimentary horn or absence of one horn. Taylor estimated that one out of 1,500 obstetric cases and one in about 2,000 gynecologic cases show this type of deformity, while others place the incidence still higher. Its practical significance has been brought out by Schaeffler (*J A M A* 117 1516, 1941), who recorded a case in which a patient was seen by nine physicians and was "unnecessarily pounded, thumped, curetted, aborted and laparotomized, mainly because of a complete double uterus which presented diagnostic difficulties during pregnancy."

Helpful diagnostic signs are irregular menses, dyspareunia, repeated unexplained abortions, and repeated malposition of the fetus. The author believes that roentgen pelvimetry should be done routinely as an aid in diagnosis.

The case of a 24-year-old white woman with a double uterus and double vagina is reported. Examination revealed the presence of a complete septum in the vagina and two distinct cervixes were palpable. A roentgenogram following injection of iodochloral showed the two cervixes, two cervical canals, two separate uteri, and two tubes—one to each of the separate uteri—clearly outlined.

HUGH A O'NEILL, M D

**Evaluation of Roentgen Pelvimetry** T G Stoddart *Canad M J* 54 50-52, January 1946

During a recent twelve-month period, the author made a roentgen study of the pelvis in approximately 100 women. Each of these was referred for roentgen consultation, and none was examined as an ordinary routine procedure. In the majority dystocia was anticipated. The usual reasons for sending obstetrical cases to the x-ray department for pelvimetry are (1) abnormal external and internal pelvic measurements, (2) a floating head at term, (3) a history of previous dystocia, (4) an elderly primipara, (5) suspected breech presentation, (6) medicolegal considerations.

The majority of this series were primiparae, and many had abnormal external measurements. Previous injury or disease of the lumbar spine and pelvis was also an indication for roentgen examination. One small group of patients had gone into labor before roentgen measurement was requested, but most of the women were ambulatory and able to cooperate fully. The examination was conducted at eight or eight and a half months in most instances, which is considered the optimum time.

The author uses a form of the Thomas method. In addition to a flat film of the abdomen and pelvis for general detail, he takes a lateral projection either with the patient erect or lying on her side. An 8 X 10 measuring film (for the lateral view) is then made, using the perforated lead grid located at a level corresponding to the mid line of the sacrum. A final anteroposterior

film is obtained with the patient semi-upright, supported on a canvas and wooden framework. Following the first exposure to outline the pelvis, a second exposure is made on this film with the perforated lead grid at the level of the inlet. This method has given very satisfactory results. The three films used for measurement permit a study of the pelvic contours as well, an important consideration, since abnormal contours may cause dystocia as readily as faulty measurements.

Complete parturition records were obtained for 72 patients. In 29 of these, approximately 40 per cent, cesarean section was done, for the following indications: disproportion (70 per cent), placenta praevia, uterine inertia and non-engagement of the head after trial labor, maternal systemic disease, breech presentation with limited pelvic capacity, toxemia, and spinal deformity or ankylosed hip.

The author's conclusions from this study are that pelvic roentgen measurements are desirable in all cases where dystocia is anticipated, that the study of the pelvic contours is to be stressed, that the optimum type of pelvis is the round or gynecoid, while the least desirable for normal childbirth is the true flat type or platypelloid.

BERNARD S KALAYJIAN, M D

**Roentgenological Visualization of the Sacral Hiatus During Late Pregnancy** Paul A Bishop *Surg Clin North America* 25 1391-1393, December 1945

For visualization of the sacral hiatus in late pregnancy, Bishop advocates an anteroposterior Bucky film. The pelvis is tilted slightly by placing a pillow under the patient's knees. The tube is adjusted 25 inches above the table top and centered at the level of the anterior-superior spine. It is then shifted caudward 17 inches and tilted cephalad at a 45-degree angle.

The film shows the shape, width, and length of the sacral hiatus as well as any secondary openings or windows above the hiatus. A description of the latter is important in caudal anesthesia since the tip of the needle follows the posterior wall of the caudal canal. Should the tip of the needle penetrate the soft tissue of a "window," the injection would be made outside the canal and anesthesia would be unsatisfactory.

ELLWOOD W GODFREY, M D

**Roentgenological Visualization of the Placenta.** Paul A Bishop *Surg Clin North America* 25 1394-1407, December 1945

By soft-tissue technique the placenta may be visualized in a vast majority of cases when 50 per cent or more of it lies above the pelvic inlet. Two lateral films are made. The first is centered over the middle of the posterior third of the fundus to record the posterior wall, the second is centered over the anterior third and the exposure is made sufficiently light to show the anterior wall. An anteroposterior film is also made with the patient lying flat on her back. With proper technique, the subcutaneous fat layer of the fetus will appear as a black line. Between this fat line and the periphery of the uterus there are four structures of the same density, the uterine wall, the skin of the fetus, the placenta, and the amniotic fluid. The first two are uniformly thin. The placenta will displace the fetal soft parts, while this is not true of amniotic fluid.

Identification of the placenta in the fundus rules out placenta praevia as a cause of uterine bleeding. The accuracy of such a negative diagnosis should be better

**Pneumoroentgenarthrography as a Diagnostic Aid in Internal Derangements of the Knee** John B Butts and John T Mitchell U S Nav M Bull 46 77-82, January 1946

In a series of 50 cases of injury to the knee in which pneumoroentgenography was carried out, 24 patients were operated upon and the roentgen diagnosis was verified in 18 (75 per cent). The authors believe that air as a contrast medium for x-ray visualization has a definite value in the diagnosis of injuries to the semilunar cartilages, in hypertrophic synovitis, in hypertrophy of the retropatellar fat pad, and in the establishment of a differential diagnosis in cases of persistent or recurrent synovitis or hemarthrosis. A 40 inch distance (tube film) with vertical (long axis of knee) tube shift of 2 1/2 inches for the stereo films was employed, one lateral and both anteroposterior (dorso, ventral) and postero-anterior stereo projections were made, with the rays paralleling the tibial articular surface. With careful positioning, 5 X 7 inch films were used in par speed cassettes. Results with the Potter-Bucky diaphragm were somewhat more satisfactory than with a non-grid technic. Roughly from 60 to 140 c.c. of air was necessary to separate the tissues properly and fill the joint space, depending upon the size and habitus of the patient, intracommunication and size of the bursae, presence of small amounts of fluid, and other factors. The procedure should be used only in patients with suspected injury or damage to non radiopaque structures within the knee, in whom a clinical diagnosis cannot be made. It should never be carried out on an acutely inflamed joint.

**A Review of 18 Cases of Arthrotomy of Knee Joints** Lowell I Thomas Mil Surgeon 98 20-24, January 1946

Eighteen cases of knee disability which came to operation are analyzed. A closer scrutiny of the preoperative roentgenograms, with the operative findings in mind, revealed that damage to cartilaginous articular surfaces may be anticipated when changes in subchondral bone density are found on the film.

Although x-rays of the knees are usually characterized by their "negativity," occasionally serial comparative films of both knees will demonstrate changes in density of subchondral bone, indicating articular surface damage. The outline of the normal femoral condyles and the normal shallow notches in the anterior surfaces of the femoral condyles can be distinguished from the abnormal, roughened, decalcified, indistinct articular surface outlines. This information is of considerable diagnostic value and is useful, with postoperative films, in checking the progress over a long period of time.

**Fractures in Electroshock Therapy as Related to Roentgenographic Spinal Findings.** James H Huddleston and Hirsch L Gordon Mil Surgeon 98 38-39, January 1946

Roentgenograms of the spine were taken of all but 9 of the first 252 psychotic patients receiving electric shock therapy at one Veterans' Facility. One hundred and forty spines were normal, the other 103 showed abnormalities of varying degree. One patient had an old pre-shock spinal fracture. Excluding this case, 13 vertebral and 3 other fractures occurred in the series. The fracture rate for normal spines was 4.3 per cent and for the abnormal 6.8 per cent, a difference of 2.5 per cent,

which the authors consider statistically insignificant. There was thus no relation between abnormalities seen in pre-electroshock spinal roentgenograms and shock induced fractures.

**Orthoroentgenography as a Method of Measuring the Bones of the Lower Extremities.** William T Green, George M Wyatt, and Margaret Anderson J Bone & Joint Surg 28 60-65, January 1946

Under certain conditions it is necessary to determine the exact length of the bones of the lower extremities. Any method of doing this should meet certain requirements (1) It should be sufficiently accurate to record the comparative true length at any one examination. (2) The precision of measurement should remain constant for varying bone lengths, in order to compute accurately the true increment of growth. (3) Sufficient detail should be delineated to show abnormalities and the epiphyseal lines.

The method described here consists of three separate exposures of the lower extremities on a cassette 14 by 48 inches, centering over the three joints successively. Sliding lead plates protect two segments of the film while the third is being exposed. A lead marker is used to center the x ray tube over the joint and to check the accuracy of the exposure. The extremities are held immobile by tapes during radiography.

Comparison of this method of measurement of long bones with others shows its great advantage and accuracy. The length can be measured directly from the films without any correction factors.

JOHN B MCANBRY, M D

## GYNECOLOGY AND OBSTETRICS

**Uterosalpingography** C M Spangler Surg Clin North America. 25 1340-1344, December 1945

In 1914 Rubin attempted to visualize the uterine and fallopian tubes using collargol. This medium was abandoned due to its irritant action on the peritoneum. In 1925 Fosdick employed lipiodol. This has subsequently fallen into disrepute for the following reasons (1) accidental injection of vessels into which the oil penetrated, (2) oil embolism, (3) non absorption of the oil from the peritoneal cavity, and (4) acute peritonitis with abscess formation. Subsequently diodrast, skiodan, and uroselectan were utilized in the hope of overcoming the objections offered by the oily medium. These, however lack the viscosity for a constantly satisfactory hysterosalpingogram. Titus utilized acacia in skiodan to increase the viscosity of the watery medium. The choice of substance utilized however, is less important than the care and technic of administration.

Uterosalpingography is employed (1) to demonstrate congenital abnormalities of the uterus and fallopian tubes, (2) to show the location of uterus and fallopian tubes in relation to other pelvic masses (3) to outline the contour and content of the uterine cavity and (4) for the localization of the site of tubal obstruction which has been previously established by repeated Rubin tests. The latter is the procedure in which uterosalpingography is of most value.

Contraindications include (1) acute vaginitis, endocervicitis or any acute pelvic infection (2) inflammatory pelvic masses, (3) menstruation, (4) pregnancy, whether uterine or extra-uterine, and (5) cardiovascular, pulmonary, and other serious systemic disease.

ELLWOOD W GODFREY, M D

Perhaps the best appraisal of what the authors have to offer may be had by quoting the legends of several of their illustrations

"Fig 3 Involuntary injection into the right renal artery The injection was too high, and the needle sunk too obliquely because of the passage of fluid into the right kidney, the injection of the external iliacs is insufficient "

"Fig 4. A poor terminal aortography The injection at the usual site was done without success, this is understandable when one considers the sinuosity of the aorta, which deviates to the left This too high injection did opacify the superior mesenteric and the renals "

"Fig 5 Endarteritis of the left iliacs The left and external iliacs have irregular borders and an inconstant caliber, due to endarteritis "

"Fig 6 Obliteration of the common iliac at its termination On the left, due to the development of a sacral branch (middle), a meshwork of collateral vessels has been established to compensate "

Other illustrations are in series, showing various alterations in the primary anatomical arrangement of the vessels springing from the bifurcation

Several observations occur to one First, in each case there is evidence of a collateral circulation Then, no surgical application of such findings as there are is made clear Certain it is, that no competent neurosurgeon would predicate a procedure upon the mere visualization or failure of visualization of some arterial branch in a preparation of this sort, as the authors themselves admit, if less than the proper amount of dye is injected, the lower branches will not be satisfactorily visualized

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Simple thrombosis of the superior vena cava is rare. Phlebography and measurement of venous pressures are the only procedures by which the diagnosis can be confirmed during life. The site of the obstruction can be demonstrated by phlebography. In the presence of obstruction the venous pressure in the upper extremities is significantly higher than that in the lower.

The authors' findings are based on a study of 35 cases, in 27 the causes were verified, and in 8 they were uncertain. Of the verified lesions, 12 were aneurysms of the ascending aorta, of which 2 had perforated into the superior vena cava, 6 were bronchiogenic carcinomas, 5 were malignant lymphomas, 2 were acute lymphocytic leukemia, 1 was a hypernephroma metastatic to the mediastinum, and another was a carcinoma of the ovaries with mediastinal metastases. Mediastinal masses were demonstrated roentgenographically in 4 of the 8 unverified cases. In the other 4 cases, there were no roentgen evidences of a mediastinal tumor and no clinical features to suggest the cause of the syndrome.

The venous pressure was measured in the antecubital vein in 34 of the 35 cases, and found to be 300 mm. or more of saline in 20, and 400 mm. or more in 12. In 6 cases it was below 200, a figure which might have been accepted as normal, had not the pressure in the femoral vein been very much lower.

Phlebograms were made in 13 cases, with diodrast or thorotrast, the injections being either in one or both antecubital veins or the external jugular vein. Several case histories and illustrations are included in the article.

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occurs approximately once in 10,000 times. It is the opinion of the author that management of the carcinoma should have precedence over the possibility of securing offspring, and that complete irradiation therapy should be used.

When the possibility of a fundal cancer is present, diagnostic curettage should always be resorted to promptly. The concept of treatment of such lesions most widely accepted at the present calls for a combination of irradiation and surgery. In the Jefferson Clinic from 1921 to 1929 patients were either treated by surgery alone or by irradiation alone. Because of the relatively low survival rate of patients treated solely with surgery, the plan of treatment was gradually changed, preliminary irradiation with radium being employed increasingly before surgery was attempted. X-ray therapy after radium, or after surgery preceded by radium, is used only if there is visual or palpable evidence of pelvic extension at operation.

If supravaginal hysterectomy has been employed in sarcoma of the uterus, with or without adnexal conservation, the outlook is dubious because of possible involvement of the retained structures. In such instances, postoperative irradiation, with radium applied to the cervical stump and x-ray therapy to the pelvis, is imperative. ELLWOOD W. GODFREY, M.D.

#### Histologic Study of the Effect of Irradiation on Adenocarcinoma of the Endometrium. Lyman M. Stowe. *Am J Obst & Gynec* 51: 57-68, January 1946.

This study is reported because the author feels that the evaluation of radium therapy has for the most part been based on clinical results in terms of five- or ten-year cure rates, or increase in survival rates, and little attention has been paid to the correlation of these results with histologic findings. His observations were made in 53 cases of adenocarcinoma of the body of the uterus in which the diagnosis was established by curettage prior to irradiation. The histologic material consisted of pan-hysterectomy and bilateral salpingo-oophorectomy specimens obtained five weeks after the completion of radiation therapy.

All patients received radium irradiation. In 7 the radium was applied in two or three capsules arranged in tandem in a long straight applicator. The dose varied from 2,000 mg hr to 4,900 mg hr. In the remaining 46 instances a jointed tandem applicator was used, with 3 or 5 capsules in series, with a platinum wall 1 mm thick. In the usual 5-capsule set-up, 4,500 to 5,000 mg hr of radiation was delivered. Twenty-three patients had deep x-ray therapy prior to operation as well as radium.

In order to make sure that no carcinoma was overlooked, the entire endometrium, together with the musculature underlying it to a depth of 0.7 to 1.0 cm, was removed and sections were made at intervals of not more than 3 mm at right angles to the surface.

A 50.9 per cent incidence of residual tumor was found. In 10 cases where x-ray was employed in adequate dosage together with radium irradiation, the incidence of residual tumor fell to 40 per cent, while in a larger series where radium alone was used the incidence was 56.5 per cent. However, the author indicates that this difference is not statistically significant. In the majority of instances where residual carcinoma was found it was in the uterine musculature.

The conclusion is reached that surgical attack must be considered to be the essential feature of curative therapy in the treatment of adenocarcinoma of the corpus uteri. It is still possible that preliminary irradiation may be useful as additional therapy or for palliation.

RUSSELL WIGH, M.D.

#### Indications for Roentgen Therapy of Bladder Carcinoma. Recognition of Suitable Cases. Franz Buschke and Simeon T. Cantril. *Surg, Gynec & Obst* 82: 29-35, January 1946.

This paper deals primarily with roentgen therapy from a curative point of view. In the treatment of those cancers of the bladder which are considered incurable by surgical or radical radiological procedures because of the extension of the disease or the general condition, radiation therapy with the purpose of palliation only has no place. It is useless and in many instances harmful. It increases the discomfort of the patient and discredits radiation therapy.

Curative roentgen therapy may be attempted with most hope of success in papillary carcinomas with a moderate degree of differentiation and without marked invasion of the bladder wall. In general the carcinoma should not have extended through the wall of the bladder, no metastases should be present, and the strength of the patient should be sufficient to support the course of therapy planned. Adequate urinary drainage must be established, and no severe infection should be present. An enlarged prostate or an occluding tumor should be removed before treatment is instituted. Prior suprapubic operations lower the possibility of adequate irradiation.

If an extensive carcinoma recurs following fulguration, or if recurrence appears likely to the operator, roentgen therapy should be instituted promptly if it is to be used at all.

Small lesions of a primarily infiltrating type are better treated by excision. If such a lesion is so located that complete bladder resection is the only surgical procedure possible, interstitial irradiation is probably superior to roentgen therapy, provided the invasive tumor is less than 3.5 cm in diameter.

No details of therapy are supplied except that treatment is given daily for six to eight weeks through three portals, at 800 kv. Of 69 patients treated from 1934 to 1943, 10 were well, 55 were dead or alive with active disease, and 4 were lost from follow-up at the time this study was made.

This is the authors' third report on supervoltage therapy of carcinoma of the bladder (for the others, see Supplement to the Staff Journal of the Swedish Hospital, Seattle, May 1941, No. 2, p. 77, *J Urol* 48: 368, 1942). They still consider their experience "too young to make final conclusions," and regard the observations set forth here as "only a working basis for further investigation."

FREDERICK A. BAVENDAM, M.D.

#### Hodgkin's Disease. VII. Treatment and Prognosis. Henry Jackson, Jr. and Frederic Parker, Jr. *New England J Med* 234: 103-110 Jan 24, 1946.

The treatment of Hodgkin's paraganuloma, due to its localized nature, may be either excision of the nodes or excision followed by irradiation. Both procedures have shown good results.

In Hodgkin's granuloma, there is no specific treatment. Biopsy should precede therapy and a complete



examination, including a chest film, should be made. Irradiation with 200 kv, 0.5-1.0 mm copper filtration, 100-200 r daily for a total depth dose of at least 500 r, should be prescribed. Supervoltage irradiation has not been used sufficiently long to determine its value. Treatment should be given cautiously in the presence of large mediastinal masses and evidence of an acute infection. Unexplained fever, abdominal pains, a persistently elevated white count, and generalized itching suggest involvement of the abdominal or para-aortic nodes. Bone lesions are usually less sensitive to radiation than other lesions, but even here irradiation often is of value, at least for relief of pain. Transfusions, general care, and surgery are often necessary. Aspirin in large doses will usually control bone pain.

Hodgkin's sarcoma is very resistant to irradiation. In most cases the disease arises in the internal organs or retroperitoneal nodes and, as a result, is often not discovered until very late.

The prognosis of Hodgkin's paraganuloma is not entirely discouraging. Of 26 patients, 54 per cent lived five years or more, and 5 have survived 15 years. Of the 12 who died, 5 succumbed to unrelated diseases, and 7 to Hodgkin's granuloma.

Hodgkin's granuloma usually leads to death in one to three years. Thirteen per cent of the authors' patients lived five or more years. An acute infectious onset usually indicates death within six months. With pulmonary involvement death is to be expected in three to eight months.

The prognosis in Hodgkin's sarcoma is poor. No patient in this series lived more than three years, 60 per cent died within two years.

JOHN B. McANENY, M.D.

**Treatment of Leukemia with Radioactive Phosphorus**  
R. Feissly. Schweiz med Wchnschr 76 8-9, Jan 5, 1946

The treatment of leukemia with radioactive isotopes depends on three factors: (1) the possibility of selective introduction into the leukemic tissues, (2) the possibility of injection in non-toxic form, (3) the possibility of injection without depositing the substance in other organs in sufficient quantity for its radioactivity to be dangerous.

$P^{32}$ , producing beta radiation, has been shown to meet these requirements. After discussing the literature, the author reports the case of a 60-year-old man with lymphatic leukemia who had become radiation-fast. Five millicuries of radiophosphorus were injected as sodium phosphate (pH 7.4), leading to a reduction of the white cells from 112,300 to 80,000 per c mm in ten days, in spite of the minute dose. The patient suffered no ill effects.

LEWIS G. JACOBS, M.D.

## BENIGN AND NON-NEOPLASTIC DISEASE

**Indications and Contraindications in the Irradiation Therapy of Benign Uterine Conditions** George A. Hahn. Surg Clin North America 25 1306-1312, December 1945

In contrasting irradiation with surgery for benign uterine conditions, Hahn states that there are differences which are at once apparent. Economically irradiation is more desirable. External irradiation does not require hospitalization while the patient who is being treated with local radium is ordinarily sent home after about a week's stay. The expense of an intra-

uterine radium application or fractional x-ray treatments is much less than that of a longer hospital stay following major uterine surgery with its attendant anesthesia, operating room, and professional fees.

In patients with vaginal bleeding, the presence of carcinoma must first be considered. Diagnostic curettage must always be performed prior to irradiation therapy, or carried out at the time of the intended radium application. ELLWOOD W. GODFREY, M.D.

**Use of Radium in the Aerotitis Control Program of the Army Air Forces** A Combined Report by the Officers Participating. Ann Otol, Rhin & Laryng 54 650-724, December 1945

Aerotitis, due to inability to ventilate the middle ear during flight, has been a major cause of disability in flying personnel. A program to reduce the incidence of aerotitis in the Army Air Forces was instituted in 1944. The attack was based primarily on the elimination of the most common cause of eustachian tube malfunction, namely, hyperplastic lymphoid tissue in the nasopharynx. Irradiation of such tissue with radium was chosen as the best and most practical method of treatment for the desired purpose. The technic was that developed by Crowe (see Burnam and Crowe. Mississippi Valley M. J. 67 109, 1945. Abst. in Radiology 47 208, 1946). Two nasopharyngeal applicators, each containing approximately 50 mg of radium sulfate, are inserted in the nasopharynx for 8.5 minutes, giving a dose of 1 gm. 25 seconds (in the earlier cases the period was slightly less, with a correspondingly decreased dose).

The present report is based on studies conducted on flying personnel in the European and Mediterranean Theatres of Operation, by medical officers attached to the Eighth, Twelfth and Fifteenth Air Forces, and in the United States to the First and Third Air Forces. All of the officers engaged in the program were otolaryngologists who were specially trained in the use of the nasopharyngoscope and in the technic of nasopharyngeal irradiation.

Every patient selected for treatment had hyperplastic lymphoid tissue in or about the eustachian tube orifices. Overseas, only the patients with a history of aerotitis or ear-ventilating difficulties were treated.

A total of 14,345 men were examined by the participating units and 6,881 were selected for treatment. The total number of treatments given was 14,045. Not a single instance of burn or ulceration of the nasopharyngeal or the nasal mucous membrane occurred in the 14,045 treatments given. A small proportion of the men had a mild stiffness of the nose, a slight sore throat, or a sensation of a head cold after treatment.

Of 636 men with a history of recurrent aerotitis, 74 per cent had less difficulty ventilating their ears during flight and 89 per cent had a marked decrease in the amount of nasopharyngeal lymphoid tissue when examined with a nasopharyngoscope, thirty days or more after the third treatment. Seventy men, or 11 per cent, showed no reduction in the amount of lymphoid tissue in the nasopharynx, and 165 men, or 26 per cent, had no subjective improvement.

The beneficial effect of prophylactic irradiation was shown by the drop in incidence of aerotitis in 778 men after high altitude flights.

The principal cause of failure to improve after irradiation treatments was the presence of a large mass of adenoids. For such patients, surgical removal, supple-

mented by irradiation, would have been more effective. In other patients various factors, such as nasal allergy, chronic sinusitis, and psychologic reactions, were found to be contributing causes for the lack of improvement.

Basic precautions were adopted to protect medical personnel and patients from overexposure to radiation. For those giving the treatments, the principal safety measure was distance. Except when placing or removing the applicators from the nasopharynx, all personnel remained at a distance of 20 feet or more. No evidence of overexposure, either of patients or of irradiation clinic personnel, was noted by any of the participating officers.

In conclusion, the use of the nasopharyngeal radium applicator is a safe, practical, and effective method of irradiating hyperplastic lymphoid tissue in the nasopharynx. In addition, irradiation of hyperplastic lymphoid tissue about the eustachian tube orifice is an effective prophylactic measure for aerotitis in flying personnel.

STEPHEN N. TAGER, M.D.

**Irradiation of the Eustachian Tube.** An Anatomic, Physical and Clinical Study of a Treatment for Recurrent Otitis Media Applied to Aero-Otitis. Edmund P. Fowler, Jr. Arch Otolaryng 43 1-11, January 1946.

A series of 80 airmen who had been grounded because of recurrent aero-otitis were treated by the application of radium or radon to the eustachian tube, 46 of these were returned to full flying duty. Since only 66 of the patients could be regarded as properly selected, treated, and followed, this represents a 69 per cent cure rate.

This brief report of results is preceded by a consideration of the anatomy and pathology of the eustachian tubes, illustrated with photomicrographs, and is followed by a discussion of the method of application. Particular emphasis is laid upon the importance of filtration. The author discusses the use of brass, platinum, and Monel metal. With platinum all the beta radiation is filtered out, but with Monel metal the radiation is mixed, beta and gamma. A table is included showing the doses in roentgens for 50 mg radium at various depths for the different filters, with different dosage times. No final conclusions as to the procedure of choice are reached.

The author mentions the possibility of using high-voltage roentgen therapy if neither radon nor radium is available. While special applicators are to be preferred, radium capsules designed for other purposes can often be adapted for insertion into the nasopharynx. The treatment is without danger in the hands of a competent radiotherapist. It not only gives successful immediate results but it forestalls the deafness which develops sooner or later from the recurrent attacks of otitis media which are almost an inevitable sequel to malfunction of the eustachian tubes.

## EFFECTS OF RADIATION

**Subtotal Replacement of the Skin of the Face for Actinodermatitis Due to Roentgenotherapy With Multiple Areas of Squamous Cell Carcinoma.** Hilger Perry Jenkins. Ann Surg 122 1042-1048, December 1945.

The patient whose history is recorded here had received x-ray therapy to the skin of the face some fifteen

[See also article on this subject by the same author, Arch Otolaryng 40 402, 1944. Abst in Radiology 45 210, 1945.]

**Case of Brucellosis Cured by Teleroentgen Therapy.** J. Amard. J de radiol et d'électrol 26 369, 1944-45.

In this article, the author attempts to convince the reader that in a case of Malta fever, by a series of treatments at a meter and a half distance, using 25 to 50 r at a seance, he materially aided the convalescence of his patient. Indeed, he puts it more strongly than that, saying "Under the influence of this treatment, as one may establish by the temperature curve, the defervescence began." Anyone familiar with Malta fever knows, of course, that the temperature occasionally declines quite by itself. In short, the author has failed entirely to establish the cause and effect relationship which he assumes. PERCY J. DELANO, M.D.

**Effect of X-Rays on Leishmania Tropica in Vitro.** B. Feldman-Muhsam and L. Halberstaedter. Brit J Radiol 19 41-43, January 1946.

On the flagellate form of *Leishmania tropica* cultivated *in vitro*, 1,250,000 r were immediately lethal. At 500,000 r some were immobilized, the proportion increasing as the dose was raised. A dose of 150,000 r destroyed the capacity for multiplication in the culture medium. The immediately lethal dose for the Donovan bodies could not be determined.

In the clinical treatment of leishmaniasis favorable results are obtained with 300 to 600 r repeated three or four times at weekly intervals. It is therefore apparent that the clinical benefit is not due to a direct effect on the parasite. SYDNEY J. HAWLEY, M.D.

## APPARATUS

**A Feed-Back Amplifier for Ionization Current.** Frank T. Farmer. Brit J Radiol 19 27-30, January 1946.

The construction of an intensity meter using a small chamber on a flexible cable is described which will measure from 1 to 50 r per minute. By using a large negative feed back the effective time constant of the instrument is reduced to a small fraction of its normal value and a linear response to radiation intensity produced. SYDNEY J. HAWLEY, M.D.

**Design of Filters to Produce "Flat" X-Ray Isodose Curves at a Given Depth.** A. E. Chester and W. Meredith. Brit J Radiol 18 382-385, December 1945.

Flattening of the isodose curves for given depths was accomplished by making stepped filters thicker toward the center. This was done only for long narrow fields. Change in dose distribution along the short axis of the field did not occur. SYDNEY J. HAWLEY, M.D.

years previously for a pustular dermatitis. Twenty-five treatments had been given, mostly within a four month period, but the dosage is not noted. Except for a burn from the treatments, the patient experienced no trouble until about twelve years later, when weeping lesions appeared which became crusted over and ulcerated. At the time of his first appearance before the

author, there was an extensive scarring of the skin of the face and multiple small squamous-cell epitheliomas developing in the scarred areas. Some cervical lymph node enlargement was present. The enlarged nodes were removed surgically and found to contain metastatic carcinoma. Despite this, the skin of the entire face was removed in stages and replaced by grafted skin. The details of the procedure are clearly outlined by the author. The end-result was excellent. The main purpose of this article is to demonstrate what can be done in the way of extensive replacement of the skin of the face following roentgen-ray reaction and development of carcinoma. **BERNARD S. KALAJIAN, M.D.**

**Carcinoma Subsequent to the Radiotherapeutic Menopause.** James A. Corscaden, John W. Fertig, and S. P. Gusberg. *Am J Obst & Gynec* 51: 1-12, January 1946.

The authors discuss here a follow-up series of 1,108 patients in whom an artificial menopause had been induced because of benign uterine bleeding, fibromyomata, or one of a few other benign conditions. Thirty-six cancerous growths were found in various parts of the body, 15 of which were in the uterus.

Some patients had been kept under observation for twenty-five years, but the general average was 6.7 years. Based on modified statistics, the same number of women in the general population, during the same length of time, should contract 4.4 carcinomas of the uterus. The observed number of cases, therefore, is 3.4 times as large as the expected number. There is not a corresponding excess of cancers in other organs.

Of the 15 uterine tumors, 9 involved the corpus and 6 the cervix. This abnormal preponderance of carcinoma of the corpus is in agreement with that present in other reported series, in which the ratio is 2 of the corpus to 1 in the cervix. It is inferred that the endometrium of uteri which bleed abnormally prior to the menopause is predisposed to the subsequent development of carcinoma.

The authors present several tables showing the length of follow-up, cases of non-uterine cancer subsequent to radiation therapy, death rates per 100,000 females from carcinoma and other malignant tumors, etc.

**PHILIP W. DORSBY, M.D.**

**Laryngeal Cancer Following Roentgen Therapy.** D. den Hoed. *Acta radiol* 27: 20-22, Jan 31, 1946. (In German.)

Cancer of the larynx developed in two middle-aged persons twenty-five years after heavy roentgen irradiation of the throat. No other etiological factors were present and the author believes that there is some connection between the irradiation and the development of the cancer.

**Histological Effects of Radiophosphorus on Normal and Lymphomatous Mice.** W. S. Graff, K. G. Scott, and J. H. Lawrence. *Am J Roentgenol* 55: 44-54, January 1946.

The effects of radiophosphorus ( $P^{32}$ ) were studied by use of a transmissible lymphoma in mice. Some of the mice were injected intravenously with  $1.2 \times 10^7$  lymphoma cells, while others were used as controls. Thirteen days after inoculation, some of the mice were given 10 c.c. of an isotonic solution of sodium phosphate intravenously which contained 195.3 microcuries of  $P^{32}$  per cubic centimeter. Some of the control animals received a similar dose of  $P^{32}$  at the same time.

Twelve other mice received a similar injection of lymphoma cells and seven days later half of these animals received four 10 c.c. subcutaneous injections (54.5 microcuries per cubic centimeter) at two-hour intervals. Four normal animals received similar  $P^{32}$  injections and 2 others were kept as controls.

The results showed an initial depressing action of  $P^{32}$  on the lymphocyte series in the peripheral blood stream. After four days, when the granulocytes began to drop off markedly, there already was an increasing deposition of  $P^{32}$  in bone. The retention of  $P^{32}$  in bone is of much longer duration than in lymphatic or any other tissue. There is no direct evidence that the neoplastic cells are more radiosensitive than other cells. It was found that, at corresponding stages in the lymphomatous process, the treated animals had less infiltration of organs by leukemic cells than the non-treated groups. In both the normal and leukemic animals, the greatest drop in white blood cells occurred during the first four days after administration of  $P^{32}$ . The chief cell type to be affected is the lymphocyte and the lymphoma or leukemic cell. During the following five days the rate of drop diminishes, but during this period the greatest decrease in granulocytes occurs.

Studies of the exchange of  $P^{32}$  in leukemic tissues of mice revealed a higher uptake than in other soft tissues. This greater uptake in neoplastic tissue is of interest, since these cells receive relatively more radiation.

Even though there is some selective irradiation, especially by virtue of  $P^{32}$  localization in infiltrated lymph nodes, spleen, and liver, one eventually faces the same problem as when using spray or local roentgen irradiation, since the whole marrow, and therefore both leukemic and normal elements, are being irradiated. These predominant effects of  $P^{32}$  on the various elements of marrow constitute the limiting factor in its use in the therapy of leukemia and make it of doubtful value in lymphosarcoma and allied diseases. The general problem is to find a radio element or compound of the element which would localize to a high degree in or immediately around the neoplastic cell. Since leukemia is such a diffuse disease, the possibilities of discovering a method of true selective irradiation are not great, and for this and other reasons we must look for the control of this disease by some other method.

**CLARENCE E. WEAVER, M.D.**

**Studies on the Effects of Radioactive Sodium and of Roentgen Rays on Normal and Leukemic Mice.** Titus C. Evans and Edith H. Qumby. *Am J Roentgenol* 55: 55-66, January 1946.

Radioactive sodium, at the present time the most readily prepared of all radioactive substances, does not concentrate in any organ or group of organs, but instead is, within a short time after its administration, distributed throughout the extracellular fluids of the body. It emits penetrating beta and gamma rays. Its half-life, 14.8 hours, is long enough to be useful and yet short enough so that dosage can be closely correlated with effect.

Normal mice were injected with amounts of radioactive sodium varying from 150 to 4,000 microcuries. Other normal mice were exposed to doses of from 350 to 1,000 r of roentgen rays, 70 per cent of the dose being administered one day and 30 per cent the next. The effects of the two treatments were found to be of the same kind. Similar changes were produced in the

differential counts Lymphocytes were more radio-sensitive than the other leukocytes In animals with leukemic adenopathy, injections of radioactive sodium produced severe leukopenia, usually of short duration In general, such animals showed more reduction in lymphocyte number than was produced by comparable amounts of radiation in controls Estimations of distribution of radioactive sodium in various organs and tissues of sacrificed animals showed that there was no considerable concentration of the material in any particular organ or tissue

The results presented indicate that the effects produced by subcutaneous injection of radioactive sodium are of the same sort as those resulting from whole body roentgen irradiation It was estimated that 10 micro-curies per gram of body weight will produce the same general effect as 100 r of roentgen rays It is emphasized that this equivalence is applicable only to mice, not to larger animals or to man In man, this amount would give a much higher dose of radiation for two reasons In the first place, whereas in the mouse practically no gamma radiation is effective, and only about three-fourths of the beta radiation, in man practically all the beta rays and a considerable portion of the gamma rays are absorbed Furthermore, the mouse eliminates about a third of the material in three days, while in this period the average human being excretes less than 10 per cent It is estimated that the "equiva-

lent roentgens" from a given dose per gram of body weight in man would be at least twice as much as in a mouse No evidence of selective concentration of the radioactive sodium in the lymph nodes was found

CLARENCE E WEAVER, M.D

**Biological Effects of Penetrating Radiations.** A Review F G Spear Brit M Bull 4 2-11, 1946. **Comparative Studies of the Biological Effects of X Rays, Neutrons and Other Ionizing Radiations** L H Gray Ibid pp 11-18 **Genetic Effects of Radiations.** D G Catchside. Ibid pp 13-24 **Action of Radiations on Viruses and Bacteria.** D E Lea Ibid pp 24-26 **Quantitative Histological Analysis of Radiation-Effects in Human Carcinomata.** Alfred Glucksmann Ibid pp 26-30 **Measurement of Radiation.** G J Neary Ibid pp 30-35 **Total Energy-Absorption in Radiotherapy** Frank Ellis Ibid pp 36-43 **On Technical Methods in X-Ray Therapy** J Read Ibid pp 43-49 **On Technical Methods in Radium Therapy** S Russ Ibid pp 49-51 **Million Volt Therapy** G S Innes Ibid pp 51-58 **Protective Methods in Radiology** W Binks Ibid pp 58-64

The first number of Volume 4 of the *British Medical Bulletin* is devoted to radiobiology in its experimental and practical aspects It comprises the papers listed above, most of which are in the nature of reviews

## EXPERIMENTAL STUDIES

**Studies on the Brown-Pearce Rabbit Carcinoma with the Aid of Radioactive Isotopes** A Forssberg and F Jacobsson Acta radiol 26 523-534, Nov 30, 1945

Since the Brown-Pearce rabbit carcinoma produces tumors in about 80 per cent of animals grafted and the course of development of the tumor and metastases is rapid, it is possible to maintain a relatively high level of radioactivity during the critical period of growth of the tumor by injection of radioactive phosphorus ( $P^{32}$ ) The author first established the distribution of radioactive isotope in the organs of normal animals, the kidneys, liver, spleen, and adrenals were found to contain greater amounts per gram of weight than other organs Rabbits having the tumor were then injected with the phosphorus at varying intervals after grafting, and recordings of the amount of radioactivity as measured by a Geiger-Müller counter in comparison with known standards were made on metastatic tissue and on the uninvolved portions of various organs

The resulting data showed no significant difference between organs from normal rabbits and the uninvolved portions of the corresponding organs from rabbits dying with the tumor However, the metastatic tissue, regardless of the organ in which it originated, showed a high and essentially equal amount of retained phosphorus of the order of magnitude of normal kidney, liver, spleen, or adrenal Excretion likewise followed a curve similar to that for the organs of higher metabolic rate. Although concentration in the metastatic tissue was high, it was somewhat greater in the rapidly growing portions of the tumor than in the older necrotic portion Extractions of preparations of tumor cells indicated greater phosphorus retention in the nucleo-

protein fraction in the rapidly growing portion of the tumor, but greater retention in the acid-soluble fraction in necrotic tissue.

The authors conclude that it would probably not be possible to treat metastases without damage to normal tissue However, they suggest the possibility of early treatment to prevent metastases and plan experiments along that line

ELIZABETH A CLARK, M.D

**Length and Width Changes in the Pulmonary Arterial System of Rabbits in Passing from the Stage of Expiration to That of Collapse as Revealed by Roentgenography** Charles C Macklin Dis of Chest 11 590-595, November-December 1945

The author has previously set forth his view that with vigorous ventilation there is change in the length and width of the pulmonary arteries and veins they increase with inspiration and decrease with expiration (Tr Roy Sc Canada, vol 39) This periodic change in the volume of blood in the pulmonary vessels rhythmically repeated, he believes, has the effect of a pump which aids the heart. Roentgen studies of rabbits show that in passing from expiration to collapse there is a similar reduction in the length and width of the arteries and veins In a unilateral pneumothorax, the blood flow is lessened, while compensatory emphysema with an increase in the size of the pulmonary vessels occurs in the contralateral lung, so that the circulation is maintained Two roentgenograms are included showing the comparative size of the vessels in moderate inflation and collapse in rabbit lungs filled with latex which had been opacified with thorotrast

HENRY K TAYLOR, M.D

# RADIOLOGY

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## Rheumatoid Spondylitis Correlation of Clinical and Roentgenographic Features<sup>1</sup>

MAJ EDWARD W BOLAND, M C, A U S,<sup>2</sup> and MAJ EMIL M SHEBESTA, M.C., A U S

**R**HEUMATOID (ankylosing) spondylitis predominantly affects males of military age. For this reason it constitutes an important and frequent cause of chronic back disability in soldiers. At the Army Rheumatism Center, Army and Navy General Hospital, 1,084 instances of the disease were observed during a twenty-two-month period, these constituted 18.1 per cent of 6,000 consecutive admissions for rheumatic conditions of all types (1).

Few examples of true "poker back" deformity or "bamboo spine" have been encountered among soldiers, such an occurrence usually led to rejection at the time of induction. The majority of soldiers with rheumatoid spondylitis have been observed during the early or relatively early phases of the disease. This has allowed an unusual opportunity for the study of the early diagnostic features, these features have been outlined elsewhere (2).

It is during the early stages of rheumatoid spondylitis that the best results may be expected from roentgen therapy to the spine, corrective and preventive postural exercises, orthopedic appliances, and other therapeutic measures. To direct such procedures intelligently, it is important to know in each case the degree of extension, the severity, and rate of progression of the

disease. Generally such information can be obtained by a correlated study of the clinical and roentgenographic features.

### CLINICAL FEATURES

The clinical picture of rheumatoid spondylitis is dependent upon such qualifying factors as the severity of the disease, the degree of spinal extension, the activity of the process at various levels of the spine, the duration of the disease, and the amount of extra-articular soft-tissue involvement. The disease may be mild, moderate, or severe, the intensity of symptoms, rate of progression, and amount of constitutional reaction will vary accordingly. The sacroiliac joints may be involved alone or, at the other extreme, the synovial joints of the entire spine may be affected. The process may be active in one area and 'burned out' or quiescent at another level. Associated soft-tissue reaction in the muscles, ligaments, or spinal nerve roots may give rise to symptoms at levels higher than the actual joint involvement. The following is a summary of the clinical features of the disease, especially those which reflect involvement of the various regions of the spine.

*Sacroiliac Involvement* Because the disease almost invariably begins in the sacroiliac joints, the symptoms and findings

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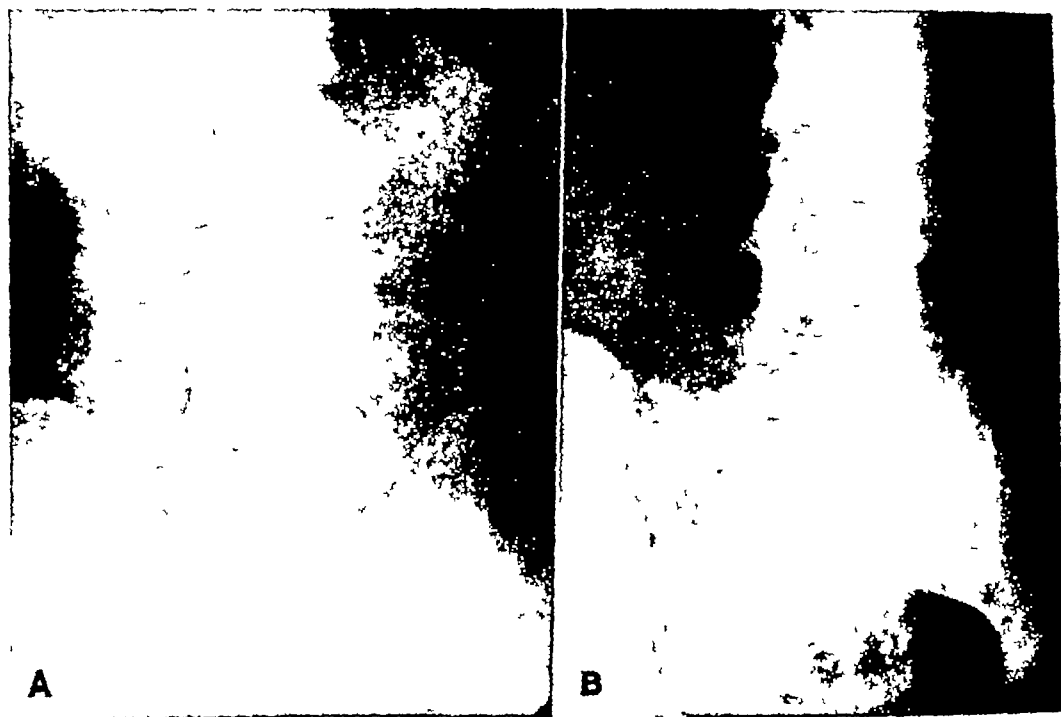


Fig 1 A. Normal sacroiliac joints. The margins are well defined and the joint space is clear. Note the absence of osteosclerosis. B. Oblique view, showing normal apophyseal joints. Note the apparent absence of the apophyseal joint space between L4 and L5 due to anomalous development, this could be mistaken for ankylosis.

referable to the lower back at onset may be considered as expressions of sacroiliac involvement. In approximately 75 per cent of cases the early symptoms consist of aching and stiffness of the lower back, which qualitatively exhibit the characteristics of "fibrositis," that is, are most pronounced on arising in the morning, are accentuated by physical inactivity and ameliorated by mild exercise, are subject to fluctuations with weather changes, and are relieved temporarily by local heat and salicylates. At first, these symptoms may be intermittent, but after several months or a few years they tend to become persistent. Transient sharp pains or "catches" in the lower back or less well defined complaints, as constant dull discomfort, a soreness, or a tired feeling (accompanied or unaccompanied by symptoms of "fibrositis"), may also indicate sacroiliac involvement. In 10 to 15 per cent of cases sciatica, often intermittent and alternating from side to side, accompanies the phase of sacroiliitis.

The back may be entirely normal on examination. In about 50 per cent of patients with active sacroiliitis, tenderness on percussion may be elicited over one or both sacroiliac joints. Orthopedic tests causing motion in the sacroiliac joints may induce pain. Mild muscle spasm in the lumbar region without true restriction of motion is common.

*Lumbar, Thoracic, and Cervical Involvement.* When the disease is active in the lumbar, thoracic, and cervical regions, the dominant symptoms consist of pain, aching, stiffness, and restriction of motion in the involved regions. Sciatica is common with lumbar involvement, girdle pains are frequent when the thoracic spine is affected, but cervical radicular pain is rare. Lumbar, thoracic, or cervical involvement may be identified by the presence of the following general signs in the respective regions of the back: limitation of motion, persistent paravertebral muscle spasm, persistent tenderness to percussion over and just lateral to the spinous processes,

pain on forced motion of the spine, paravertebral muscle atrophy. Involvement of the lumbar spine is further characterized by straightening of the normal lordotic curve and by muscle atrophy in the lower portion of the lumbar segment, giving this area an "ironed-out" appearance. Thoracic involvement may be further identified by chest pain on deep inspiration, restricted respiratory excursion, flattened anterior chest, and thoracic kyphosis. A characteristic protruded position of the neck may develop when the cervical spine is involved.

*Constitutional Reaction and Laboratory Findings* Weakness, fatigue, anorexia, weight loss, and low-grade fever vary with the severity of the process. Such symptoms generally are not prominent except when the disease is severe or when peripheral arthritis coexists. The erythrocyte sedimentation rate is a fairly consistent gauge of activity in spondylitis and roughly parallels the severity of the disease, however, in 15 to 20 per cent of mild but clinically active cases it may be within normal range. In about one-fourth of the cases a moderate hypochromic anemia exists, severe anemia is rare.

#### ROENTGENOGRAPHIC FEATURES

Alterations in the sacroiliac joints constitute the most diagnostically reliable and almost invariably the earliest roentgenographic findings in rheumatoid spondylitis. The first changes consist of subchondral bony sclerosis and/or spotty demineralization, usually located in the juxta-articular portion of the ilium, particularly at the caudal third of the joint. Later the juxta-articular portion of the sacrum may show similar changes. Involvement is usually bilateral but not always symmetrical in degree. As the process progresses, demineralization and bony condensation cover a wider subcortical zone, but the two processes may not keep pace with each other, one or the other predominating.

The sacroiliac joint at first appears blurred and the margins are indistinct. The joint space may give the false impression of being



Fig 2 Typical bilateral sacroiliac involvement. The joint spaces appear widened, due to rarefaction of the articular cortices. Note the juxta-articular osteosclerosis, especially of the ilia.

widened or it may appear narrowed. Varying degrees of joint dissolution may occur, the margins may appear serrated, or there may be irregular mottling (Figs 1 and 2). With further progression, the joint space is traversed by bony trabeculae, gradually fusion between the sacrum and ilium occurs (Fig 3). With the development of ankylosis, subchondral sclerosis gradually fades and the bone density of the adjacent ilium and sacrum eventually becomes normal or less than normal. If spotty rarefaction has been pronounced, residues of such change may be evident long after ankylosis is complete (Fig 4).

Roentgenographic changes in the lumbar, thoracic, and cervical regions are not found as consistently nor are they so diagnostic as the sacroiliac changes. The most common finding consists in calcification of the paravertebral ligaments, especially the anterior longitudinal ligament, this is usually first observed at the lower thoracic and upper lumbar levels. Extensive calcific and later osseous changes in the para-



Fig 3 A Partial ankylosis of the sacroiliac joints. Mottled rarefaction (arrows) and osteosclerosis are still prominent. B Oblique view, showing partial ankylosis of the lower portion of the left sacroiliac joint. The lumbar spine was involved clinically, yet the apophyseal joints appear roentgenographically normal. Sacroiliac joint changes are usually advanced long before the apophyseal joints show changes.

TABLE I. CRITERIA FOR SEVERITY OF RHEUMATOID SPONDYLITIS BASED ON CLINICAL APPRAISAL

Severity	Onset	Rate of Progression	Degree of Disability	Constitutional Reaction	Sedimentation Rate	Poker Back Deformity (Progressive Cases)
Mild	Insidious	Slow	Mild	Minimal or absent	Normal or slightly elevated	15 to 25 years
Moderate	Usually insidious	Moderate	Moderate	Not marked but definite	Moderately elevated	5 to 10 years
Severe	Often abrupt	Rapid	Marked	Marked	Markedly elevated	1 to 3 years

vertebral ligaments give rise to the well known advanced and terminal picture of "bamboo spine" (Figs 4 and 5). Care must be taken not to confuse calcification or ossification of the longitudinal ligaments with hypertrophic spurs, hypertrophic changes usually have a broader base and arise nearer the articular edge of the vertebral body.

Roentgen changes in the apophyseal articulations are inconstant, but when present they are similar to those found in the sacroiliac joints. They consist of juxta-articular rarefaction and/or sclerosis of the facets, irregularity of the articular

margins, narrowing of the joint spaces, and eventual ankylosis (Fig 6). Examination of these articulations is difficult because of the wide variations which exist in the joint planes, often several views with different degrees of obliquity are needed for accurate study. The joint between the fourth and fifth lumbar vertebrae is particularly difficult to demonstrate adequately, frequently one facet has a convex articular surface while the surface of the contiguous facet is concave. The resulting picture may be erroneously interpreted as ankylosis (Fig 1, B). Even when definite changes are present, only one or a few



scattered apophyseal joints may be roentgenographically involved. Almost always the sacroiliac findings are more definite and of more diagnostic value.

The vertebral bodies frequently show rather square anterior articular margins instead of the normally slightly rounded edges (Fig 7), in severe cases or late in the disease they may be slightly osteoporotic. Straightening of the normal lordotic curve is common when the lumbar segment is involved.

The intervertebral disks remain normal. Judging from how commonly restriction of chest expansion is observed, the costovertebral joints must be frequently involved, but they rarely show abnormal roentgenographic findings. Calcification of their capsules may occasionally be observed late in the disease.

The symphysis pubis occasionally may be involved, it may appear widened with ragged margins, later, ankylosis may occur. Involvement of the ischial tuberosities is but rarely seen (Fig 4).

#### MATERIAL AND METHOD OF STUDY

Fifty soldiers with roentgenographically proved rheumatoid spondylitis were studied. X-ray changes in the sacroiliac joints, characteristic of the disease, were present in every case. The clinical and roentgenographic findings were first studied independently and then correlated while the patients were still under observation in the hospital. Determinations of the severity, duration, and extension of the disease were made on the basis of clinical appraisal.

The severity was gauged by the rapidity of progression of the disease, the amount of constitutional reaction, the degree of disability presented, the erythrocyte sedimentation rate, and the degree of anemia (Table I), 27 cases were classified as mild, 20 as moderate, and 3 as severe.

The duration of the disease was calculated from the onset of back symptoms characteristic of spondylitis. The average duration of symptoms for the series was 4 1/2 years, the shortest duration being seven months and the longest fifteen years.



Fig 4 Complete ankylosis of the sacroiliac joints and extensive ligamentous calcification ("bamboo spine"). Subchondral osteosclerosis is no longer present but residual rarefaction of the articular margins can be identified. This roentgenogram illustrates two unusual findings: (1) changes in the symphysis pubis similar to early sacroiliac changes (Fig 2) and (2) involvement of the cortices of the ischial tuberosities.

The degree of spinal extension was determined by the clinical findings already outlined. There were clinical signs of sacroiliac involvement alone in 9 of the 50 patients, of sacroiliac and lumbar involvement in 21, sacroiliac and thoracic in 2, sacroiliac, lumbar, and thoracic in 13, sacroiliac, lumbar, and cervical in 1, and of all the spinal segments in 4.

Anteroposterior, lateral, and oblique roentgenograms of the lumbar and sacral regions were obtained in each case. Anteroposterior and lateral films of the thoracic spine were made routinely. When evidence of clinical involvement was present in the thoracic spine, oblique roentgenograms were also studied. Oblique views were obtained with a rotation of 45 degrees for the cervical spine, 20 degrees for the thoracic spine, and 35 degrees for the lumbar spine. Additional special projections



Fig 5 A "Bamboo spine" with calcification of ligaments between spinous processes. This roentgenogram is most unusual because the sacroiliac joints, although involved, are not ankylosed. The sacroiliac joints are almost always completely ankylosed when extensive ligamentous calcification is present. B Lateral view demonstrating calcification and/or ossification of all the spinal ligaments including the ligamenta flava. The apophyseal joints are ankylosed. The intervertebral disks are well preserved. Note the straight lumbar spine.

were often necessary in order to depict adequately all the lumbar or thoracic apophyseal joints. In most instances we were able to study successfully the sacroiliac and lumbar apophyseal joints on single 10 X 12-inch roentgenograms by rotating the pelvis approximately 25 degrees and by rotating the upper lumbar spine 35 degrees. Although a postero-anterior view may at times depict the sacroiliac joint spaces more clearly, the anteroposterior projection was found entirely satisfactory for routine interpretation.

#### CORRELATION OF CLINICAL AND ROENTGENOGRAPHIC FINDINGS

*Severity.* The severity of rheumatoid spondylitis as appraised clinically, was reflected, as a rule, by the qualitative roentgenographic changes in the sacroiliac

joints. In general, the amount and the proportions of subchondral sclerosis and rarefaction, and the degree of joint destruction, varied with the severity of the disease. After ankylosis had developed, such correlation was not so evident.

In mild cases the first changes in the sacroiliac joints usually consist of a zone of subchondral iliac sclerosis, haziness of the joint space, and loss of definition of the articular margins. As the disease progresses, sclerosis in the ilium covers a wider zone and the juxta-articular portion of the sacrum shows similar changes (Fig 8). The articular space becomes progressively more narrowed, gradually, over a period of years, fusion occurs. Spotty juxta-articular rarefaction is rarely conspicuous, often it is entirely absent. Actual joint mottling is usually minimal or absent.

In cases of moderate severity the first changes consist of juxta-articular sclerosis and spotty rarefaction, together with apparent widening and blurring of the articular space. As the disease progresses, the bony sclerosis and the rarefaction become more extensive, but both processes proceed in more or less equal proportions.

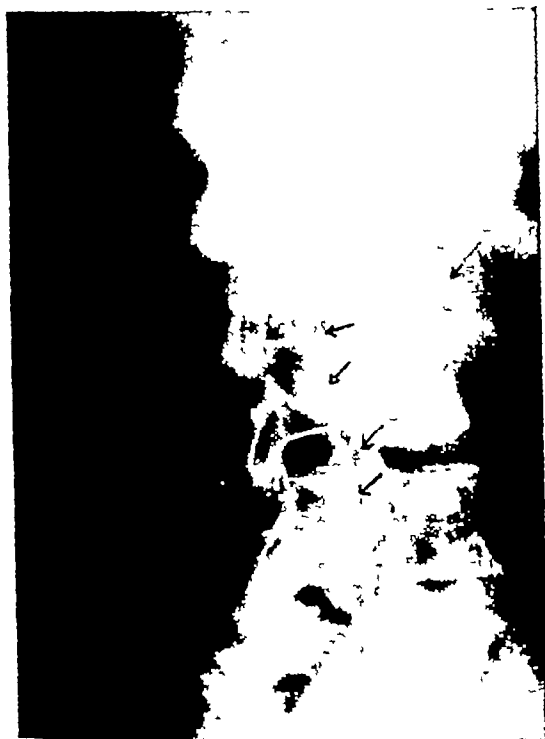


Fig 6 Apophyseal joint changes. The articular facets of L3 and L4 show mottled rarefaction, and the joint spaces appear irregularly widened (arrow), between the 'moth-eaten' areas the joint space appears narrowed. Note that ligamentous calcification is already present (arrow).

The joint space shows mottling with irregularity of its margins (Fig 9). Gradually, as fusion takes place, osseous fibers can be seen traversing the joint, and its space becomes irregularly narrowed. After ankylosis has developed, sclerosis gradually lessens, but even with complete fusion tell-tale evidence of spotty rarefaction is often observed.

In severe cases the predominant findings in the sacroiliac articulations consist of extensive juxta-articular spotty rarefaction and marked destructive changes in the joint space and

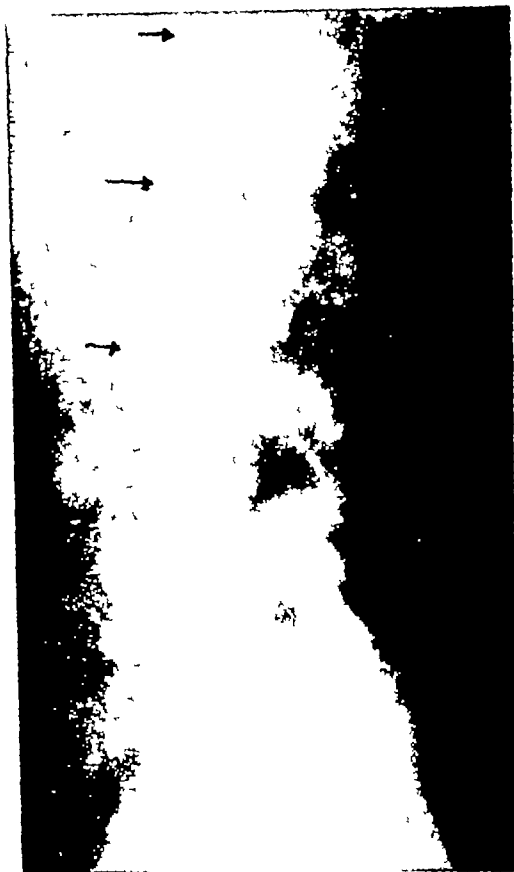


Fig 7 "Squaring" of the vertebral bodies (arrows), a common finding in rheumatoid spondylitis.

serration of the margins usually are extreme (Fig 10). Subchondral sclerosis is rarely prominent; it may be entirely absent early in the disease.

**Duration.** Characteristic x-ray changes in the sacroiliac joints may not develop until months after the onset of persistent low back symptoms (2). We have followed several patients with typical symptoms and physical and laboratory findings of rheumatoid spondylitis, but with normal roentgenograms, who after one, two, or three years have finally shown characteristic sacroiliac lesions. No information, however, was obtained from the present study regarding the time interval between the first clinical and roentgenographic manifestations, since x-ray changes in the sacroiliac joints were necessary criteria for the selection of our cases.

The time necessary for ankylosis of the

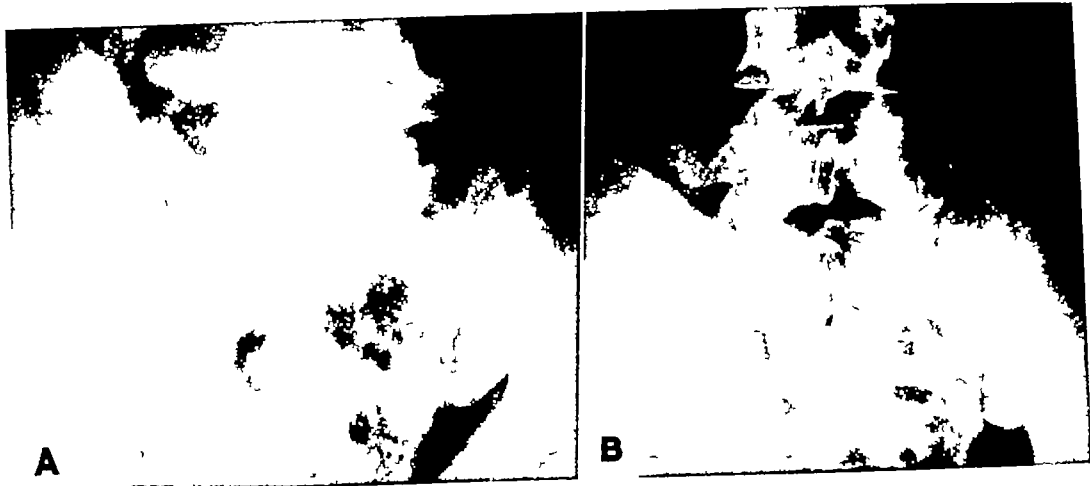


Fig 8 Characteristic sacroiliac findings in mild rheumatoid spondylitis. The predominant changes consist of juxta articular osteosclerosis and haziness and narrowing of the joint spaces. Subchondral rarefaction is minimal.



Fig 9 Sacroiliac joint changes in moderate rheumatoid spondylitis. Note the mottled subchondral rarefaction (arrows), this is rarely conspicuous in mild cases. The joint space appears irregularly widened and the margins are poorly defined. The rarefaction is accompanied by a fairly equal amount of osteosclerosis.

sacroiliac joints to develop was extremely variable and seemingly depended on (a) the severity of the disease and (b) whether the process was relentlessly progressive or was subject to exacerbations and remissions. Partial ankylosis was observed in 16 of the 50 cases. One case of moderate

severity showed partial ankylosis as early as two years after the onset of symptoms, while at the other extreme one mild case, with a history of exacerbations and remissions of back symptoms, failed to show any evidence of fusion after fifteen years. Complete ankylosis was present in 6 cases

The duration of symptoms in those patients showing ankylosis is charted in Table II

Calcification or ossification of the paravertebral ligaments was a relatively late manifestation (Table III). Ligamentous calcification was found as early as two years after the onset of symptoms in 2 cases, but several patients with symptoms for over eight years failed to show any evidence of such change. Four patients showed extensive "bambooning", one had symptoms for six years, but the average duration was nine years.

Only 9 of the 50 cases presented definite roentgenographic changes in the apophyseal joints. These appeared no earlier than ligamentous calcification or, for that matter, than partial ankylosis of the sacroiliac joints, two severe fulminating cases showing extensive apophyseal changes were exceptions (Table III).

**Extension.** The degree of extension, as determined by clinical findings, was greater than that determined by x-ray abnormal-



Fig 10 Sacroiliac joint findings in severe rheumatoid spondylitis. There is marked destruction of the sacroiliac joints. Subchondral rarefaction is much more pronounced than osteosclerosis.

TABLE II ANKYLOSIS OF SACROILIAC JOINTS IN RELATION TO DURATION OF RHEUMATOID SPONDYLITIS

Cases	Average Duration of Symptoms (years)	Partial Ankylosis			Complete Ankylosis		
		No of Cases	Duration of Symptoms (years)		No of Cases	Duration of Symptoms (years)	
			Average	Shortest		Average	Shortest
Mild 27 cases	4.8 (1 to 15)	6	8.2	4.0	0	0	0
Moderate 20 cases	4.1 (1 to 9)	10	4.7	2.0	6	7.8	5.0
Severe 3 cases	0.9 (0.58 to 1.25)	0	0	0	0	0	0

ties in approximately two-thirds of the 50 cases. The degree of extension was the same by both examinations in the remaining one-third, and in 9 of these 16 cases both clinical and roentgenographic involvement was restricted to the sacroiliac joints. In 41 patients there were definite clinical signs of involvement above the sacroiliac joints, the lumbar region being affected in 39, the thoracic in 19, and the cervical in 5. Of these 41 patients, approximately one-half (20 patients) failed to show corresponding roentgenographic changes above the sacroiliac joints. In only 2 instances were x-ray alterations found at a level higher than that expected from

clinical evaluation, in both of these, early ligamentous calcification was demonstrable in the lower thoracic region.

The most common roentgenographic abnormality found in the lumbar, thoracic, and cervical regions was calcification of vertebral ligaments. Of the 21 patients with x-ray findings above the sacroiliac joints, 19 had ligamentous calcification. In contrast, only 9 patients had demonstrable alterations in the apophyseal joints, and in 7 of these ligamentous calcification co-existed. Undoubtedly, if our patients had been studied later in the course of the disease, apophyseal lesions would have been more common and more extensive. But

TABLE III LIGAMENTOUS CALCIFICATION AND APOPHYSEAL JOINT CHANGES IN RELATION TO DURATION OF RHEUMATOID SPONDYLITIS

Cases	Average Duration of Symptoms (years)	Ligamentous Calcification			Apophyseal Joint Alterations		
		No of Cases	Duration of Symptoms (years)		No of Cases	Duration of Symptoms (years)	
			Average	Shortest		Average	Shortest
Mild 27 cases	4.8 (1 to 15)	7	6.6	2.0	2	8.0	4.0
Moderate 20 cases	4.1 (1 to 9)	14	5.0	2.0	5	6.0	3.0
Severe 3 cases	0.91 (0.58 to 1.25)	0	0	0	2	0.75	0.58

even when rheumatoid spondylitis is moderately advanced, x-ray alterations in these joints are inconstant and are of less value than ligamentous calcification in judging roentgenographic extension. We have obtained no information from detailed studies of the apophyseal joints which was not already obvious from physical examination.

#### DISCUSSION

In attempting to explain the various musculoskeletal symptoms associated with rheumatoid arthritis, it is well to keep in mind that, whereas the articular structures are principally involved, similar pathologic changes occur in extra-articular structures such as muscles, tendons, fasciae, and bursae. There is abundant clinical evidence, and some pathologic proof (3, 4), that the lesions of rheumatoid arthritis are widespread throughout the musculoskeletal system, such changes often being distant from sites of joint involvement. Of particular clinical importance are those symptoms resulting from associated involvement of the muscles and periarticular fibrous structures.

Although rheumatoid spondylitis has certain peculiarities which are not shared by peripheral rheumatoid arthritis, such as a predilection for males and a tendency toward calcification of ligaments, the disease is probably but the spinal variant of rheumatoid arthritis. The best evidence for this connection is that typical peripheral rheumatoid arthritis coexists in 25 to 30 per cent of cases. Biopsy specimens taken from the joints in such cases show microscopic changes identical with those found in peripheral rheumatoid arthritis

without spondylitis (5). Pathologic specimens taken from apophyseal joints during active phases of spondylitis reveal microscopic findings similar to those seen in peripheral rheumatoid arthritis (6, 7).

The principal pathologic lesions in rheumatoid spondylitis consist of synovitis, chondritis, and juxta-articular osteitis of the sacroiliac, apophyseal, and costovertebral joints, but associated changes, such as paravertebral ligamentitis, periarticular capsulitis, and intramuscular fibrositis, probably coexist. Calcification of ligaments and joint capsules probably serves as indirect evidence of ligamentitis and capsulitis (8, 9). Pathologic evidence of inflammatory reactions in the erector spinae muscles is lacking, but inflammatory changes have been found in the muscles in conjunction with peripheral rheumatoid arthritis (3). The aching, stiffness, and local tenderness of the back muscles, so prominent in spondylitis, certainly suggest muscular involvement. It is difficult to explain the intermittent diffuse low back symptoms, unassociated with localizing signs of lumbar spinal involvement, which so commonly accompany the phase of sacroilitis without admitting the existence of secondary changes in the muscles and ligaments.

As in rheumatoid arthritis involving peripheral joints, intra-articular roentgenographic abnormalities occurring in the spinal joints result from destruction of articular cartilage and from alterations in subchondral bone. When the pathologic process is restricted to the synovial membrane, roentgenograms are negative. It may take months or years for the develop-

ment of sufficient cartilaginous or osseous change to be recorded on roentgenograms, though pathologically involved, some joints may never show positive x-ray findings. These considerations explain the time interval which exists between the development of localizing physical signs and the appearance of roentgenographic changes.

From the present study, it is apparent that involvement clinically is often one or two spinal segments higher than that noted roentgenographically. If x-ray therapy to the spine is to be given for this disease, it is obvious that the regions selected for treatment should be chosen on the basis of clinical rather than roentgenographic involvement.

#### SUMMARY AND CONCLUSIONS

Rheumatoid spondylitis has been found to be a frequent and important cause of chronic back disability in soldiers, 1,084 soldiers with this disease were admitted to an Army Rheumatism Center during a twenty-two-month period.

Fifty cases of rheumatoid spondylitis were studied clinically and roentgenographically, and an attempt was made to correlate the findings.

The severity of the disease, as appraised clinically, was usually reflected by the character of the sacroiliac changes. In mild cases, juxta-articular sclerosis and narrowing of the joint were the predominant features, subchondral rarefaction was minimal and joint motting was not prominent. In moderate cases, observed before ankylosis, subchondral rarefaction and sclerosis were present in fairly equal proportions, and motting of the joint was definite. In severe cases, juxta-articular rarefaction and joint destruction were extreme, subchondral sclerosis was not so conspicuous.

X-ray changes in the sacroiliac joints may not develop for months or for two to three years after the onset of back symptoms characteristic of rheumatoid spondylitis. The time necessary for ankylosis of the sacroiliac joints to develop was variable and seemingly depended upon the severity

of the disease and whether the process was relentlessly progressive or subject to exacerbations and remissions.

Calcification of the paravertebral ligaments was a relatively late manifestation but constituted the most common x-ray finding above the sacroiliac joints. Definite roentgenographic changes in the apophyseal joints were inconstant even when the disease was moderately advanced, apophyseal alterations, as a rule, occurred no earlier than ligamentous calcification or partial ankylosis of the sacroiliac joints.

In approximately two-thirds of the 50 cases studied, the degree of extension as determined by clinical findings was greater than that determined by roentgenographic changes.

The general clinical and roentgenographic features of the disease have been discussed. An attempt has been made to explain certain symptoms of rheumatoid spondylitis on the basis of associated changes in the extra-articular soft tissues.

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# Giant-Cell Tumors of Soft-Tissue Origin<sup>1</sup>

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THE BENIGN giant-cell tumor is the most common neoplasm occurring in the periarticular tissues, ligaments, tendons, and bursae located near joints. Jaffe, Lichtenstein, and Sutro, in 1941, added 55 cases to a total of 339 previously reported in the literature. The tumor is variously known as xanthoma, myeloplaxoma, endothelioma, myeloma, and granulation-tissue tumor. The other benign tumors occurring in the same areas are chondroma, osteochondroma, ganglioma, lipoma, fibroma, and angioma. Malignant neoplasms are rare and include chondrosarcoma, fibrosarcoma, and the so-called malignant synovioma. These latter are subdivided into spindle-cell, alveolar, and anaplastic types.

## INCIDENCE AND LOCATIONS

A good cross section of the relative incidence of both benign and malignant tumors is given by Geschickter and Lewis in a report from the Surgical Pathological Laboratory of Johns Hopkins University, as follows:

	Cases
Giant cell tumor of tendon sheath origin	50
Ganglioma	40
Osteochondroma	7
Fibroma	4
Lipoma	2
Angioma	0
Chondrosarcoma	2
Sarcoma (fascial type in tendons and sheaths)	5

Charache found 5 giant-cell tumors of the tendon sheaths in a series of 16,500 hospital admissions and 157,000 clinic admissions but, oddly, all were seen in 1939-40. Schreiner and Wehr, in 1934, reported that among a total of 11,212 malignant and 7,110 benign tumors seen in their clinic, of which 265 (128 malignant

and 137 benign) occurred in the hand, there were 7 giant-cell tumors of the tendon sheaths.

Galloway, Broders and Ghormley, of the Mayo Clinic, in 1940 reported 70 cases showing 88 soft-tissue giant-cell tumors. 82 occurred in tendon sheaths and 6 in the synovia of the knee joint. Of those in the tendon sheaths, 64 were in the upper extremity. Of that number, 54 involved the fingers and 38 of the 54 were in the fingers of the right hand. Of the 88 tumors, 60 occurred on the right extremities. The middle finger was most commonly involved, and the most common site was the distal phalanx. Of 68 tumors of this series, 28 were on flexor and 37 on extensor surfaces, the remainder were not classified. In their review of the literature, Galloway and his associates found that the single most common site was the flexor surface of the right index finger. These statistics are typical of all reported in the literature except those of Lewis, who, among 50 cases, found 32 involving tendons at the metacarpophalangeal or interphalangeal joints on the flexor side.

The giant-cell tumors arising in synovia have a predilection for the knee. Galloway *et al* found 43 cases in the literature, of which 37 were in the knee, about equally distributed as to right and left sides, 3 were in the ankle, and 3 in the tarsal joints. Their own 6 cases all involved the knee.

## AGE AND SEX

Most authors place the peak of incidence in the third and fourth decades. In Galloway's report, the sex was given in 236 cases, 55 per cent were in females. The average age of 119 women was thirty-seven years, and of 101 men, thirty-eight years.

<sup>1</sup> From the Department of Radiology, the Lahey Clinic, Boston, Mass. Read by title at the Thirty first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov 9-10, 1945.



Ages ranged from five to eighty-two years. The peak of incidence was in the third decade.

#### SYMPTOMS AND SIGNS

The usual complaint is the occurrence of a slowly growing mass which causes mechanical difficulty with a joint or creates a fear of malignant growth. Galloway found that in 133 cases reported in the literature in which the tendon sheath was involved, symptoms had been present for an average of five years and four months, in 23 synovial tumors, the average duration was three years and eleven months before treatment or advice was sought.

The average tumor of tendon sheath type is a small mass 1.5 to 2.0 cm in diameter, which can be palpated subcutaneously in the vicinity of a tendon and is not fixed to the skin. The motion of the tendon is not affected except by mechanical block due to the bulk of the tumor. In the synovial type, particularly when the knee is involved, the symptoms are said by Galloway to be similar to those of internal derangement of the knee. Jaffe *et al* stated that these synovial lesions of the knee produce a serosanguineous fluid, the presence of which should make one think of a giant-cell lesion. Roentgenologic examination in the case of the larger diffuse tumors may show pressure erosion of bone, the smaller ones produce no bone or joint changes.

#### DIFFERENTIAL DIAGNOSIS

Mason and Woolston, who reviewed the literature in 1927, stated that giant-cell tumors of the tendon sheaths are among the most common of all tumors occurring in the fingers and should be differentiated from the following conditions, in the order given:

- (a) Chondroma Harder than a giant-cell tumor
- (b) Lipoma Softer than a giant-cell tumor
- (c) Carcinoma Skin involved and fixed
- (d) Osteoma Fixed to bone

- (e) Ganglioma More commonly seen on dorsum of wrist
- (f) Tuberculosis No differential criteria given
- (g) Fibroma Very rare
- (h) Tumors of tendons Exceedingly rare

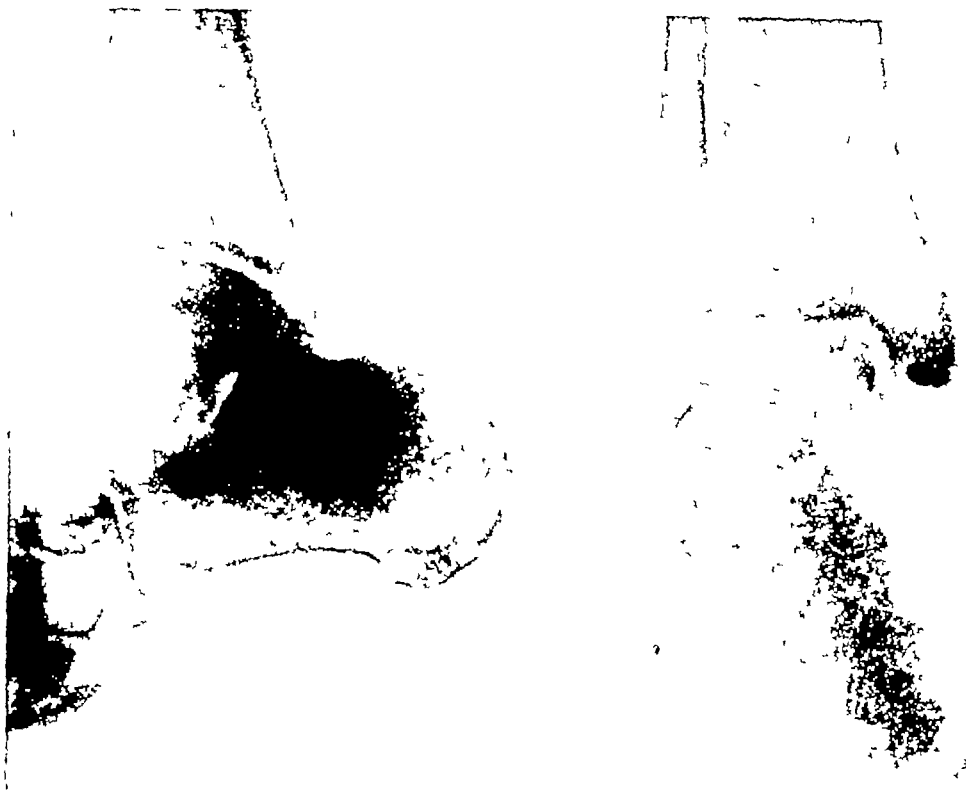
#### PATHOLOGY

The tendon-sheath tumors are firm, lobulated, grayish-white masses, showing streaks or areas of yellow and yellow-brown. They have a fibrous capsule and do not invade the tendon or the tendon-sheath space. Nor do they invade bone, though they may cause pressure erosion if they reach sufficient size. The majority are small, as mentioned above, but they may attain a diameter of 5 cm even on a finger or toe. The synovial type may be circumscribed, as in the tendon sheaths, pedunculated, or diffuse. None has been known to metastasize.

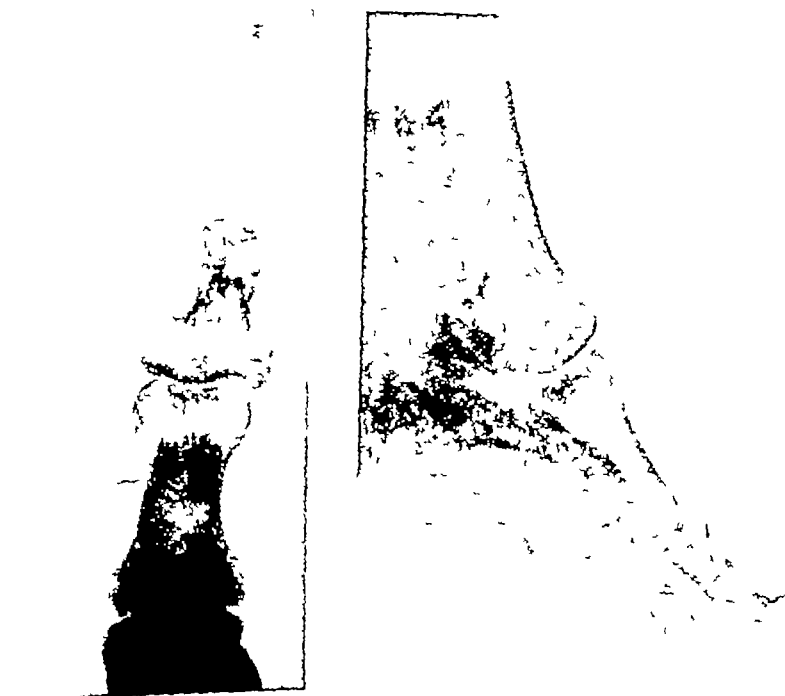
Microscopically, the tumors are characterized by the presence of giant cells, hemosiderin, macrophages, and foam cells in varying numbers. The presence of hemosiderin and lipid accounts for the yellow and brown color patterns. The type cell seems to be a large polyhedral cell. There may be varying numbers of spaces lined by synovial-like cells, containing varying amounts of lipid material, and/or nests of hemosiderin, macrophages, small giant cells, and foam cells. Galloway *et al* state that the color in these tumors is due to the presence of carotin and xanthophyll and not to the cholesterol.

#### TREATMENT AND PROGNOSIS

All writers are agreed that the treatment of choice is surgical excision. Rarely this may be impossible, as in the case reported by Cristol and Gill, in which two previous excisions had failed to remove the lesion in the tarsal joints and it became necessary to amputate the foot and ankle. The amputated specimen showed xanthomatous infiltration throughout the foot. Galloway *et al* reported surgical excision in 69 of their 70 cases (88 tumors), the seventieth



Figs 1 and 2 Case I Roentgenograms showing a soft-tissue mass but no bone changes



Figs 3 and 4 Case II Giant-cell tumor arising in the tendon sheath, no bone changes.

patient coming to the Mayo Clinic immediately after excision. Eight patients had additional radiation therapy. One, with a diffuse synovial tumor, was subjected to total synovectomy. Recurrence took place in 9 cases, and 5 patients had a second excision, while 1 patient had excision plus radiation. Of the 70 patients, 12 had recurrent lesions on admission to the Mayo Clinic, 10 had one recurrence and 2 had two recurrences. The interval between the original excision and recurrence varied from six days (recurrence?) to eleven years.

Freedman and Ginzler reported promising results with x-ray therapy in 2 recurrent lesions of the diffuse synovial type.

#### CASE REPORTS

**CASE I** A 52-year-old housewife with hypertension, adenoma of the thyroid, and a recent history of cerebral accident had a tumor approximately 6 X 10 cm. in the posteromedial aspect of the right foot and ankle. It had been present for three years and was gradually enlarging. It felt cystic, and the overlying skin had a bluish tinge. It was apparently attached to the internal malleolus. Roentgenograms showed no bone changes, but merely differentiated a soft-tissue mass (see Figs 1 and 2). On May 20, 1944, a lobulated, dark brown, semicystic mass was excised which extended down the compartment of the medial plantar nerve and up the compartment of the posterior tibial nerve. It was impossible to clean out the tumor from the medial and plantar aspects of the os calcaneus and the adjacent tarsal bones. Microscopic examination showed a giant-cell tumor of tendon sheath origin. Unfortunately, the only follow-up was on July 17, 1944, the wound was then incompletely healed and there was considerable edema of the foot and leg.

**CASE II** A 39-year-old hairdresser, admitted for menorrhagia in 1937, complained also of swelling of the left great toe, of unknown duration. Physical examination showed a tender, firm, discrete mass, 2 X 3 cm., attached to deep tissue. Roentgenograms showed no bone changes (Figs 3 and 4). At operation, in April 1939, a lobulated, discrete tumor attached to the plantar aspect of the proximal phalanx, embracing the long flexor tendon and extending back into the foot, was completely removed. The microscopic diagnosis was giant-cell tumor of tendon-sheath origin with a focus of slowly growing *fibrosarcoma*. The latest information was obtained in August 1942 in a letter from the patient, in which she said there were no symptoms and no evidence of recurrence.



Fig 5 Case III Roentgenograms showing a soft-tissue mass on the medial aspect of the proximal phalanx, of the middle finger with pressure erosion of the bone.

**CASE III** A 59-year-old housewife was admitted in 1937 complaining of a lump in the middle finger, which she first noticed in 1934. It seemed to have appeared suddenly and enlarged slowly. Physical examination showed several small cystic masses on either side of the proximal interphalangeal joint. Roentgenograms showed a soft-tissue mass on the medial aspect of the proximal phalanx, with pressure erosion of the phalanx (Fig 5). At operation, in October 1937, a mass 2 X 1.5 X 1.5 cm. was removed from the lateral aspect, and a mass 1 cm. in diameter from the medial aspect of the proximal phalanx of the middle finger. The larger mass was partly fibrotic and partly cystic, the cysts containing gelatinous material. The smaller mass was smooth and firmly nodular. It was light gray in color with foci of brownish-gray material. Both were adherent to the *extensor* tendon. The diagnosis on microscopic examination was giant-cell tumor of the tendon sheath. One year later, when the patient was last seen, there was no recurrence.

**CASE IV** A 59-year-old housewife presented as an incidental problem, in September 1933, a discrete, firm, sharply demarcated, slightly cyanotic, non-tender mass on the dorsum of the left index finger. The exact length of time it had been present was not known. A roentgenogram showed a soft-tissue mass projecting posteriorly and radially from the middle phalanx. There were no bone changes. A mass 2.5 cm. in length was excised, and the pathologic report was benign giant-cell tumor. In March 1936 there was a recurrence, and a mass approximately 1.0 cm. in diameter was removed. There has been no subsequent recurrence.

## DISCUSSION

In contrast to the unanimity of agreement as to the clinical course and treatment of these tumors are the divergent theories as to their cause. Of contributors to the modern literature, King, Morton, Ragins, and Shively, as well as many others, believe that these are true tumors arising from cells of the synovial membrane lining the tendon sheaths, joints, and adjacent bursae. King believes that the cells lying at the junction of synovia and cartilage show transition from the one type of tissue to the other, and that these cells become the growth center for the tumors under discussion. In this transition zone, the synovial cells become widely separated in the stroma, and King calls them pseudo-cartilage. From them is derived the cartilage found in synovial membrane. Thus, he believes, also explains the presence of chondromas in tendon sheaths. He regards the spaces occurring in these giant-cell growths, which are lined by tumor cells, as an attempt by the tumor to form synovial spaces. The similarity in appearance between the papillary projections which occur in tendon-sheath giant-cell tumor and those found in the synovial tumors of joints is cited as additional proof for his thesis. King also noted that some of the vascular spaces in the tumors are lined by tumor cells and hence are angiomatous. He considers the angiomatous tumors of tendon sheaths to be vascular synovial growths. Another point of interest he makes is that the villi occurring in chronic inflammation of tendon sheaths and those occurring in tumors of the tendon sheaths are covered by the same type of synovial cell. King does not postulate cell rests.

Geschickter and Copeland, and Lewis, also consider these lesions true tumors, but believe they arise from cell rests at the site of tendon insertions to bone. They call these cell rests precartilaginous cells and hold that, since these precartilaginous cells are capable of producing both bone and cartilage, they may constitute a source, also, of osteochondroma and chondrosarcoma. In

the opinion of these investigators, the ability of giant cells to proliferate in the embryo during resorption of calcified cartilage, to phagocytize lipoids, and to produce xanthomatous cells, is a satisfactory explanation of the causation of soft-tissue giant-cell tumors. A further argument for postulating the presence of cell rests is that those portions of tendons, ligaments, and joints not related histogenetically to skeletal tissue rarely show tumors of the giant-cell type. Moreover, these giant-cell tumors of soft tissue are similar to skeletal tumors of the same name. Geschickter and his co-workers also included the ganglion of tendon sheaths in this group of tumors. The ganglion, they believe, represents mucoid degeneration of cartilage.

Another argument advanced by these authors is that the tendon-sheath giant-cell tumors arise in relation to sesamoids. This was also noted by Pfitzer. Geschickter *et al* call attention to the similarity of the soft-tissue giant-cell tumors to those of the patella. Incidentally, the 16 reported cases of giant-cell tumor of the patella collected by Levine in 1943 all had a history of direct trauma to the patella. Levine gave as his opinion that the patellar giant-cell tumors were granulomas resulting from organization of hematomas in the marrow.

Jaffe, Lichtenstein, and Sutro are of the opinion that the giant-cell tumors of soft-tissue origin are related histogenetically to the hemorrhagic villous synovitis of joints, tendons, and bursae, and that the difference in both gross appearance and microscopic picture can be accounted for by the fact that the lesion in the tendon sheath is manifested much later in its course and has undergone much fibrous involution. The gross appearance is also modified by confinement in the small area occupied by the tendon sheath. It is interesting at this point to recall that King noted the similarity of tendon-sheath tumors to those of the synovia of joints and also the similarity of the synovial-like cells lining the villi to those in chronic inflammation of tendon sheaths. Jaffe and his associates, however,

believe that the giant-cell tumors of soft tissue and hemorrhagic villous synovitis are not neoplastic but represent an inflammatory response to an as yet unknown agent

Mason and Woolston, who reviewed the literature and added 8 cases of soft-tissue giant-cell tumor, found that 6 of their 8 patients gave a definite history of repeated trauma to the site of the lesion. They, therefore, also believed that these tumors represent an inflammatory response and are not neoplastic. In one of their cases the tumor arose in the palmar fascia, and one joint lesion came from fibrous tissue, in a case cited from Seyler the tumor arose from the perineurium of the ulnar nerve. These cases are hard to explain on the basis of cartilaginous rests or the presence of sesamoids.

Galloway, Broders, and Ghormley, in the excellent review quoted above, disputed the sesamoid theory of origin by stating that half of their total of 88 tumors occurred in extensor tendon sheaths where sesamoids do not exist. They agree with Thannhauser and Magendantz that these lesions are primary essential xanthomas. They believe that two factors are involved: first, a pre-existing disturbance of lipid metabolism, second, either trauma or infection at the site of the local lesion. Of 12 cases in which blood lipid studies were carried out at the Mayo Clinic, 6 showed elevation of the total blood lipids, 5 showed an increased and 3 a decreased ratio between cholesterol and its esters. In 44 per cent of the 70 cases studied by Galloway *et al* there was a history of specific trauma to the part involved, 20 per cent had arthritis, 7 per cent had both trauma and infection, and 55 per cent had either infection or trauma.

Bisgard, in 1937, while experimenting with growth repair in bone defects produced by excision of a segment of the radius in rabbits, inadvertently dislocated the distal ulnar epiphysis in 12 legs. In 5 of these spontaneous reduction occurred, the remaining 7 showed growth disturbances manifested by retardation of length and

deviation of the shaft away from its normal long axis. In addition, tumors developed in 2 cases simple osteomas and in 3 cases osteochondromas similar to those seen in man. In the last 2 cases the tumors were soft and friable, reddish-brown, circumscribed, and extending to the epiphyseal cartilage (such tumors in man arise in the epiphysis and not the metaphysis, but only after closure of the epiphyseal line). Roentgenologically, and in their gross and microscopic appearance, these 2 tumors were giant-cell tumors. Bisgard, therefore, believes that giant-cell tumors are related to trauma with hemorrhage.

#### SUMMARY

- 1 Soft-tissue giant-cell tumors are not rare. They occur widely, wherever there are joints and tendons. They are most frequently seen in the hand, where they are among the most common of tumors.

- 2 Surgery, with complete excision, is the treatment of choice. Recurrence is likely to follow incomplete removal, especially in the joints.

- 3 The tumors have not been known to metastasize and do not invade bone, though they cause erosion of bone by pressure.

- 4 The more recent writers regard these tumors as of traumatic rather than of neoplastic origin. It seems probable that there is a relationship between (1) giant-cell tumors of soft-tissue origin, (2) chronic inflammation of tendon sheaths, and (3) the so-called hemorrhagic villous synovitis.

- 5 One of the writer's cases showed a focus of slowly growing fibrosarcoma.

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# Osteohydatidosis: Its Radiological Features<sup>1</sup>

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OSSEOUS INVOLVEMENT occurs in only a small proportion of cases of echinococcus infestation, probably about 1 per cent. The six-hooked embryo of the *Taenia echinococcus* reaches the bone by way of the arterial circulation, establishing itself in the interstices of the spongy tissue, usually in the most highly vascularized areas, as in the epiphyseal ends of the long bones. Microvesicles replace the medullary tissue, molding themselves to the contours of the bony spaces and diffusely infiltrating the bone. Since there is no intermixture of connective-tissue elements, no adventitious membrane is formed, as in other parts of the body. Hydatid disease of the bone thus differs in two respects from hydatid disease elsewhere, namely (a) exogenous vesiculation and (b) absence of an adventitious membrane. "Hydatid cyst" of the bone is, therefore, a misnomer, not in accord with the facts, and should be replaced by the term osteohydatidosis.

In the lungs and other viscera, the characteristic feature of hydatid disease is a large cyst containing the hydatid fluid and the germinal layer, surrounded by a fibrous capsule representing the reaction of the adjacent tissues. When the parasite lodges in bone, however, it is unable, because of the resistance of the tissue, to follow its usual mode of development and therefore assumes an exogenous type of vesiculation. The microvesicles arising in the walls of the primary vesicle advance eccentrically, taking on an independent existence and producing "granddaughter vesicles," which invade the bony tissue. This process, so far as the bone is concerned, is in the nature of a mechanical effect and may continue silently for years without exciting any reaction such as an osteitis. Only later is there an associated necrosis of toxic or ischemic origin.



Fig 1 Hydatidosis of the innominate bone. This is a relatively frequent location. Rarefaction of the bone predominates.

As the bone is infiltrated, destroyed, and replaced by the exogenous hydatids (Fig 1), the integrity of the cortex is not at first interrupted and the general configuration of the bone is unchanged. Eventually, however, with progressive invasion, the cortex also gives way, and extra-osseous signs of hydatidosis become evident. Among the most significant of these is the ossifluent abscess of hydatid origin. Once the periosteum is penetrated, the vesicles are no longer imprisoned within the confines of the bone, and growth assumes a more rapid pace. The adjacent tissues react in an attempt at encystment, and a common adventitious membrane is formed, enclosing numerous vesicles of various size. The abscess thus formed has no germinal layer, which should always suggest its

<sup>1</sup> Accepted for publication in May 1946

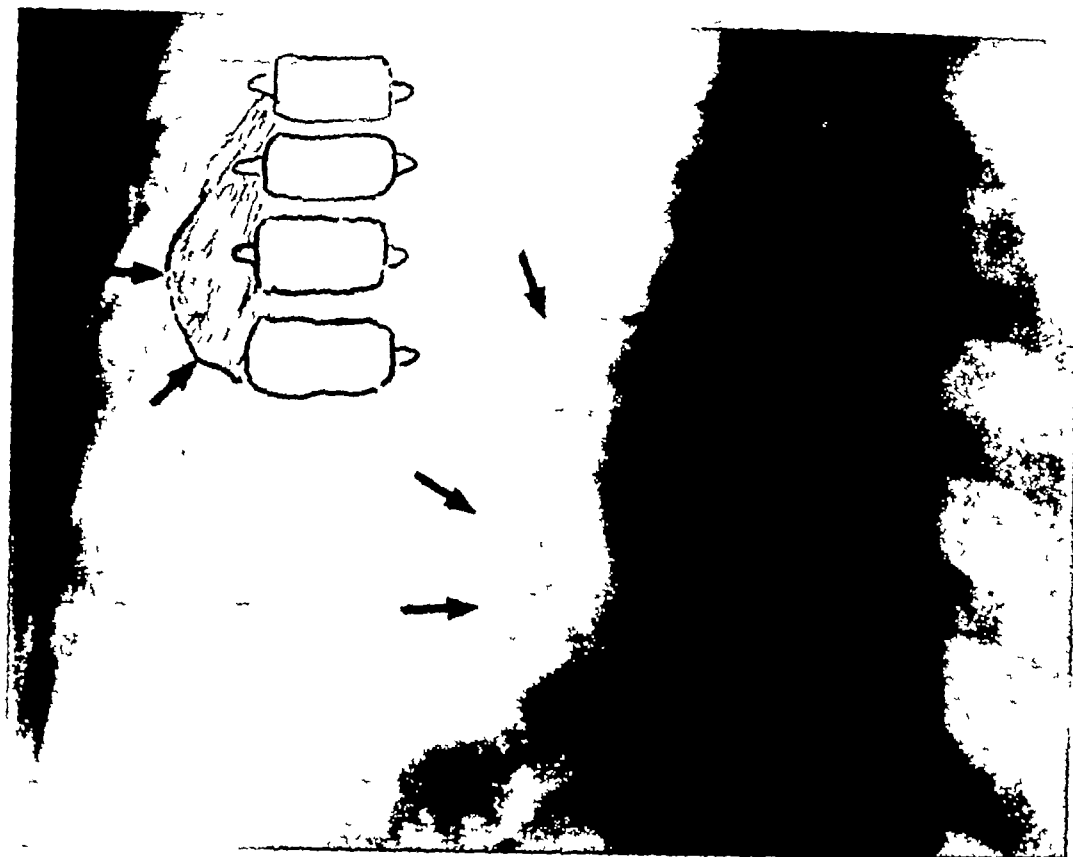


Fig 2 Extra-osseous hydatidosis Hydatid abscess with softening of the bone (ossifluent abscess) There are no radiographic signs permitting differentiation from a tuberculous abscess, but the vertebral lesion is characteristic of hydatidosis

bony origin. Growth is slow and may continue over a period of years.

Just as there is an absence of clinical signs of osteohydatidosis over a long period, so there is an absence of radiologic manifestations of the bony changes. In general, the development may be said to comprise two stages. In the *first stage*, which is that of microvesicular infiltration of the osseous tissues, the vesicles enlarge, the areolar pattern of the bone is destroyed, and there may appear on the film rounded cyst-like spaces limited by thin trabeculae, producing the appearance of a bunch of grapes (Leborgne).

The *second stage*, occurring late in the course of the disease, is one of engrafted infection, with the development of an inflammatory osteitis, which is absent in the earlier stage. Calcification of the trabeculae confirms the presence of a secondary

infection, and the resulting hyperostosis and condensation process may cause the disappearance of the grape-like shadows seen in the earlier stage.

The reaction of the bone, meantime, progresses beyond the site of parasitic involvement, encroaching upon sound tissue, which is slowly and insensibly broken down. There is no sharp demarcation between the normal and diseased areas of bone (Fig 1), which, as will be shown later, is of importance for the differential diagnosis. As a rule, the infection associated with osteohydatidosis is not of the rapidly progressive type but is characterized by a gradual evolution. As a result of this prolonged irritation, hyperostosis is usually predominant over osteolysis.

The periosteum does not react to the hydatid process and presents a normal appearance unless involved by the second-





Fig 3 Vertebral hydatidosis The vertical dimensions of the vertebral body are preserved, there is no narrowing of the intervertebral space The invaded vertebra presents a tendency to eburnation rather than to formation of cyst-like spaces

dary infection, when it responds with the usual characteristics of osteitis (Barcia) There are no changes in the contour of the bone in this stage

*Complications of Radiologic Interest* Infection has already been discussed It is a late complication When osteitis occurs, the hyperostotic reaction furnishes radiologic evidence of a process which might otherwise remain unnoticed

*Pathological fractures* may occur in the involved bone as a result of the slightest trauma, and may be the first feature to call attention to the underlying lesion, often symptomless theretofore As stated above, until the invasion of the cortex, the external architecture of the bone remains unaltered Consolidation of the fracture may occur, but such healed fractures are not always clearly visible on the film and numerous projections may be necessary for their demonstration

The *ossifluent abscess* produced after penetration of the cortex into the adjacent soft tissues is seen as a rounded shadow on the roentgen film (Fig 2) While such an abscess may occur in the vicinity of any infested bone, it will be demonstrable roentgenologically only in areas suitable for x-ray visualization, unless a contrast medium is employed In some cases, calcification of the adventitious membrane simplifies the roentgen demonstration An ossifluent hydatid abscess complicating hydatidosis of the dorsal spine requires differentiation from pulmonary hydatid cyst This is not always an easy matter, and it may be necessary to resort to a pneumothorax, according to the technic of Arce, which will settle the question If the mass is situated within the lung parenchyma, it will collapse along with the lung Otherwise, it will remain attached to the costal wall



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ential feature The vertebral lamina are often the site of parasitic involvement

*Differential Diagnosis* The first stage of osteohydatidosis may be mistaken for such rarefying bone lesions as osteosarcoma, where an osteolytic process is predominant and the bone shows a characteristic "moth-

stead of the infiltration of the spongy tissue characterizing hydatid involvement

Vertebral angioma may resemble osteohydatidosis radiologically, but the clinical signs are distinctive Chondromas lack the extensive and diffuse invasive tendency of hydatid disease

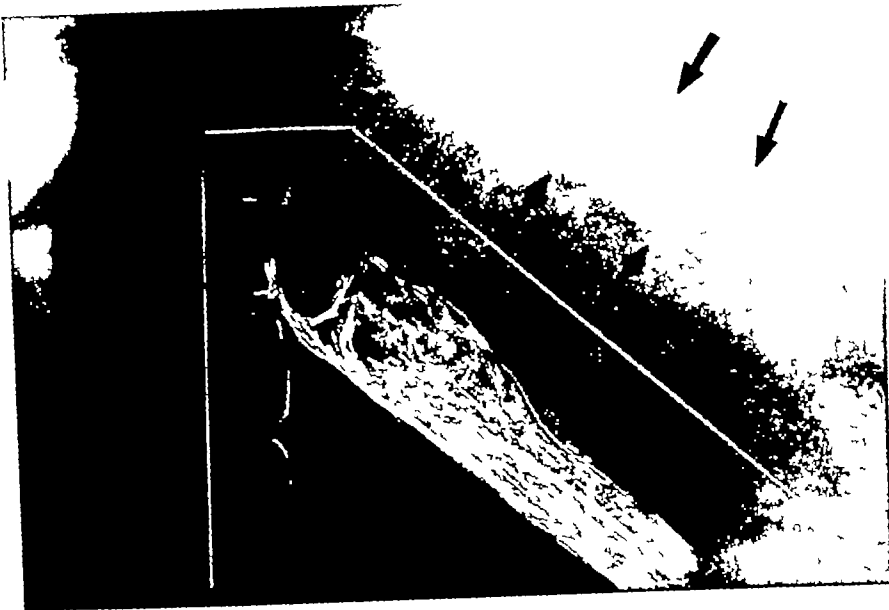


Fig 5 Coexisting hydatidosis of the ribs and vertebrae The osteolytic process predominates Note discrete periosteal reaction of the inferior border of the invaded rib

eaten" appearance In sarcoma, however, the distinguishing feature is the presence of striations in the periosteal region at right angles to the bone surface—the so-called "sun-ray appearance"

Differentiation from giant-cell tumor may also be difficult, but in the latter there is a sharp boundary between the normal and diseased bone, which is not the case in hydatidosis

Von Recklinghausen's disease (osteitis fibrosa cystica) may be differentiated on the basis of the multiple involvement in that condition, in doubtful cases a complete examination of the skeleton is indicated Determinations of the blood and urine calcium lend further confirmation to the diagnosis

In the solitary bone cyst the bone is "blown up" precociously and there are thinning and expansion of the cortex in-

Once infection has become established, confusion with the conditions mentioned no longer enters into consideration, since the picture is one of vacuolar spaces separated by bony rings showing all the irregularities characteristic of osteitis With progressive hyperostosis the bone becomes increasingly opaque, with eventual disappearance of the reticular structure Mention should be made here of syphilis and tuberculosis, the bony lesions of which are easily confused with osteohydatidosis, especially in the presence of infection

From the foregoing discussion it is seen that in its earliest stage osteohydatidosis does not permit of an unequivocal radiologic diagnosis Its occurrence should, however, be suggested by its gradual evolution, its slight effect on the general condition of the patient, and the successive bony changes which are demonstrable on

### *Radiologic Features of Osteohydatidosis*

The spongy tissue of the vertebral bodies is a favorite site of hydatid bone disease. Nearly 50 per cent of all cases of osteohydatidosis involve the spine, with the bony pelvis following in order of frequency (Ivanissevich, Prat and Barcia). Rocher,

any decrease in the height of the body of the vertebra such as is characteristic of Pott's disease. The intervertebral fibrocartilage is not attacked and the intervertebral space remains free of involvement (Fig 3). On the contrary, there is often calcification or replacement of the



Fig 4 Hydatidosis of the ribs. There is a change in the architecture and in the shape of the rib with a predominance of cyst-like rarefaction and moderate osteitis.

quoted by Ivanissevich, assigns much significance to the so-called "coffee-bean deformity."

Vertebral hydatidosis shows no tendency to the formation of interosseous cyst-like spaces which weaken the vertebral body. For that reason it is not usual to observe

lamina by newly formed bone. Coexistent with the vertebral disease, there is usually involvement of the contiguous rib (Figs 4 and 5).

As pointed out by Garcia Capurro and Ivanissevich, this is a sign peculiar to vertebral hydatidosis and an important differ-

# Roentgen Diagnosis of Duodenal Ulcer in the Right Lateral Decubitus Position<sup>1</sup>

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SINCE THE introduction of the roentgen method in the diagnosis of gastroduodenal lesions, various technical procedures have been devised from time to time in order to increase the percentage of accurate diagnoses. The one which has been and is still being extensively used con-

that all of these more or less complicated procedures do help in recognizing abnormal changes in the stomach and duodenum, but if the same end can be achieved in a simpler way, as we believe that it can, there is no special advantage in resorting to them.

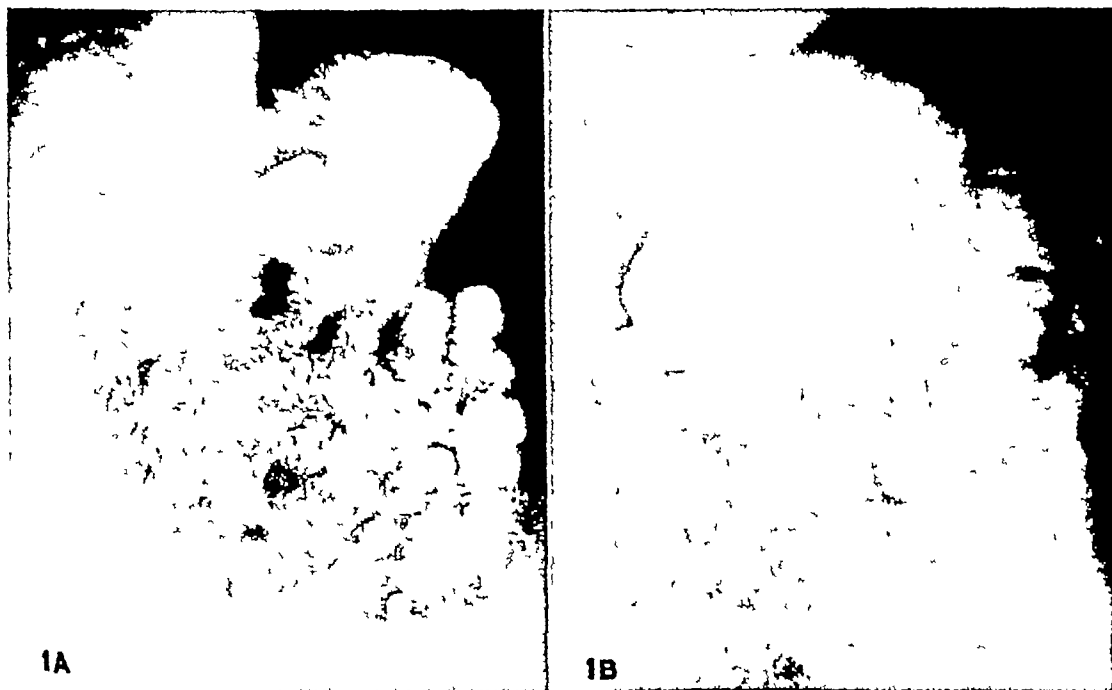


Fig 1 A The average type of normal stomach and duodenum, showing the lesser and greater curvatures in the anterior position

B Right lateral view of stomach and duodenum, showing the anterior and posterior walls

sists of filling the stomach with barium suspension and observing it fluoroscopically, after which one or more roentgenograms are made in the postero-anterior position. In the great majority of cases this technic has been found quite satisfactory for demonstrating the presence of a gastroduodenal lesion. The newer methods include serial films, the compression technic, the spot-film technic, and the use of the filming fluoroscope. There is no doubt

The method which has been used in our laboratory for many years with satisfactory results in the case of the stomach and duodenum is based upon one of the most fundamental principles underlying roentgenography, that is, the making of two projections at right angles of any part of the body to be examined. Such a procedure gives one a three-dimensional study of the part under investigation. The value of this technic is fully recognized in general roentgenology, it is equally valuable in

<sup>1</sup> Accepted for publication in December 1945

the roentgen film In cases of doubt, puncture biopsy may be advisable

#### SUMMARY

While osteohydatidosis has no pathognomonic radiological signs, certain more or less characteristic features permit us to make the diagnosis with a fair degree of assurance, namely

(a) The osteogenic reaction in the walls of the cyst-like spaces

(b) Lack of a clear demarcation between involved and uninvolved bone

(c) An associated involvement of the adjacent rib in the presence of vertebral involvement

(d) The slow development and absence of any systemic effect even in advanced cases

Puncture biopsy is recommended in any bone condition where the radiologic and clinical features do not permit of a definite diagnosis In hydatid disease of the bone such a procedure can be carried out with none of the dangers that would be present in the case of visceral hydatidosis

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3A



3B



4B



Fig 3 A Anterior view of the stomach The duodenal bulb is completely obscured by the pylorus  
 B Right lateral view The duodenum is seen in its entirety The bulb is small, showing an ulcer niche on its upper margin  
 Fig 4 A Anterior view of the stomach The duodenal bulb is overlapped by the pylorus  
 B Right lateral view, showing a large ulcer arising from the upper margin of the deformed bulb



Fig 2 A Anterior view of the stomach in a hypersthenic subject The bulb is completely obscured by the pylorus  
B Right lateral view of stomach The duodenum is well outlined in its entire course

examination of the stomach and duodenum

The three-dimensional study of the stomach and duodenum is obtained by making two views, postero-anterior and right lateral in the horizontal position. These views are illustrated by Figure 1, A and B, respectively. The anterior view shows the normal outline of the average stomach and duodenum with their lesser and greater curvatures. It fails, however, to show the contour of the anterior and posterior walls, and does not demonstrate the true relationships of the several parts in the abdominal cavity. On the other hand, the right lateral view does these very things. Special attention is called to the anteroposterior direction of the superior segment of the duodenum, this is naturally foreshortened in the ventral position and thus a good deal of the contour, with any possible abnormality, is completely obliterated from sight. Furthermore, in hypersthenic subjects and under certain abnormal conditions, the duodenal bulb is often completely obscured by the overlapping pylorus, as shown by Figure 2, A and B.

The roentgen study of lesions of the duodenum is concerned with three types of bulbs. In the first type the bulb is completely obscured by the pylorus and, in order to visualize it, the right lateral projection is essential. Several representative cases (Figs 3-6) have been chosen in order to emphasize the value of the lateral projection in this type of duodenum.

In Figure 3, the anterior view (A) shows a steer-horn shaped stomach in which the duodenal bulb is not seen. In the right lateral view (B), the outline of the entire duodenum is clearly shown. The bulb is small, and a penetrating ulcer is noted on its upper surface.

In Figure 4, the anterior view (A) shows the same type of stomach as the previous example, with the bulb completely obscured by the pylorus. In the right lateral view (B) the duodenal bulb is markedly deformed. A large penetrating ulcer is seen arising from its upper surface and a diverticulum from its lower surface.

In Figure 5, the anterior view (A) again shows a steer-horn type of stomach. The pylorus is somewhat dilated and displaced





Fig 7 A Anterior view of the stomach and duodenum The bulb is ill defined  
 B Right lateral view, showing an ulcer niche projecting from the upper margin of a deformed bulb

to the right, obscuring the bulb. In the right lateral view (B), an ulcer crater is seen in the wall of the bulb, surrounded by a halo due to swelling of the ulcer margin.

In Figure 6, the anterior view (A) shows marked dilatation of the entire stomach. The pylorus is displaced to the right, completely overlapping the bulb. In the lateral view (B) the duodenal bulb is shown to be narrow and its contour more or less deformed as a result of a chronic obstructive ulcer.

The second type of duodenal bulb as demonstrated in the frontal projection shows a constant ill-defined contour indicative of a lesion. In the lateral projection, however, the extent of the lesion is often revealed more fully and at times an ulcer crater may be recognized even though not seen in the frontal view. Three cases (Figs 7-9) have been chosen to represent this type of bulb.

In Figure 7, the anterior view (A) shows an irregular duodenal bulb suggestive of a

lesion. In the right lateral view (B) an ulcer niche is readily seen projecting from the upper margin of the bulb.

In Figure 8, the anterior view (A) shows a deformed bulb which is quite narrow. In the right lateral view (B) two ulcer craters are seen arising from the upper margin of the bulb.

In Figure 9, the anterior view (A) shows a deformed bulb which is very small. In the right lateral view (B) a large ulcer crater is seen arising from the lower margin of the constricted bulb.

The third type of bulb is well outlined in the frontal projection and it may easily be passed as normal. When, however, it is observed in the lateral position, the so-called normal bulb may show the presence of a constant deformity indicative of an ulcer. The reason for such a discrepancy is not difficult to explain. As mentioned before, the course of the superior duodenal segment is from before backward, which results in foreshortening of the bulb in the



Fig 5 A Anterior view of the stomach, which is somewhat displaced to the right obscuring the duodenal bulb  
 B Right lateral view showing a large ulcer surrounded by a thick ulcer margin  
 Fig 6 A Anterior view of a dilated pylorus obscuring the duodenal bulb  
 B Right lateral view The duodenal bulb is narrow and deformed as a result of a chronic ulcer

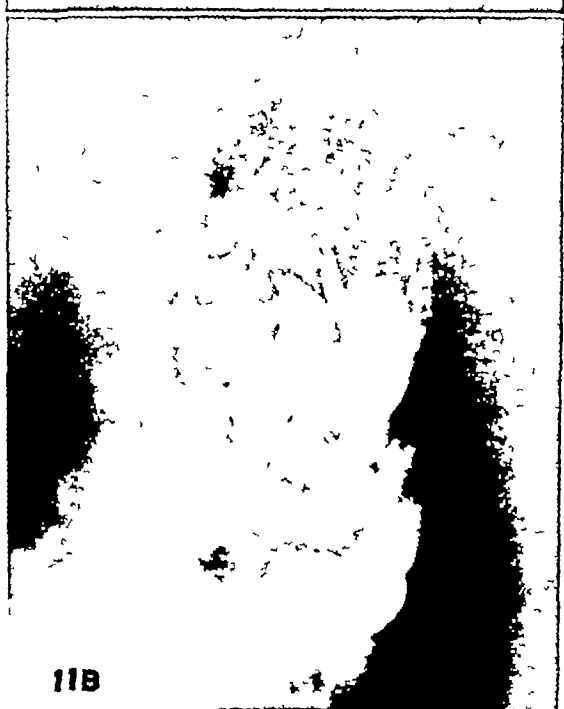
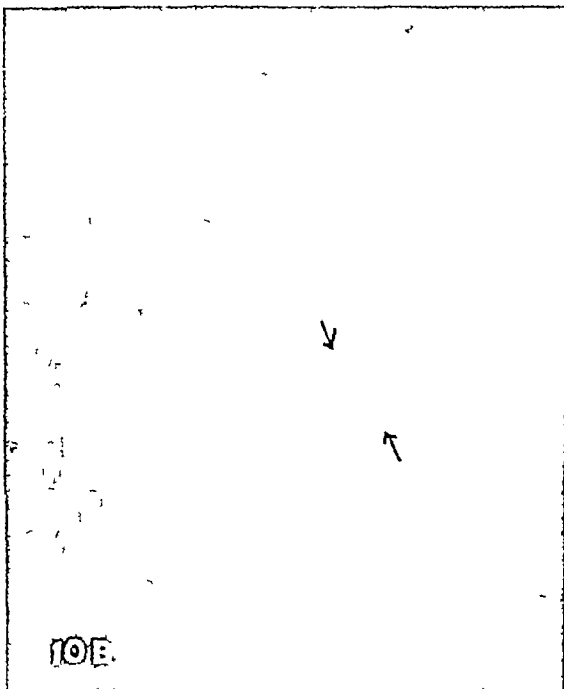


Fig 10 A Anterior view of the stomach and duodenum showing no defects in the contour  
 B Right lateral view showing a deformed bulb with large ulcer crater  
 Fig 11 A Anterior view of the stomach and duodenum, showing no defects in the contour  
 B Right lateral view showing a marked deformity in the contour of the bulb



8A



8B



9A



9B

Fig 8 A Anterior view of the stomach and duodenum The bulb is small and deformed  
 B Right lateral view, showing two niches in the upper margin of the deformed bulb  
 Fig 9 A Anterior view of the stomach The bulb is deformed  
 B Right lateral view, showing a large ulcer crater with stricture of the deformed bulb

# Cancer of the Breast

A Study of Patients Treated Over a Period of Twenty Years in the Radiation Therapy Department of Bellevue Hospital, New York City<sup>1</sup>

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THERE ARE FEW problems of radiation therapy which have given rise to more contention than that of the employment of radiation in the treatment of breast cancer. Is it at all worth while? Is it best administered as an adjunct to surgery, preoperatively or postoperatively, or should it be given solely for palliation in advanced cases? What part does it play in the control of the primary cancer, in prolonging life, in destroying metastatic foci? All these questions have been raised and shuttled to and fro between surgeon and radiation therapist, between general practitioner and specialist. Advocates of one view or the other have offered statistics of all kinds, mostly, however, representing a biased selection.

Bellevue, the largest municipal general hospital in the country, offers an opportunity for intensive investigation and study of all types of cancer in all stages and in sufficient number to permit one becoming conversant with all phases of the disease. Since it offers its services gratis, there can be no issue of cost necessary to the treatment of any specific case. Economic considerations play no controlling interest in the length of time or in the type of procedure employed in the treatment of cases assigned to the various services. Furthermore, because of its association with several large teaching organizations, such a hospital permits of specialization in care and method seldom possible in smaller, less fortunately situated institutions.

Inasmuch as this hospital is available to all citizens, regardless of race, creed, color,

economic status, or previous medical care, it receives numerous patients with breast lesions previously seen and often treated elsewhere. Thus, over a period of twenty years, its Radiation Therapy Department has had the unique opportunity of observing not only patients admitted directly without previous medical care, but many who, prior to their admission to Bellevue, have already been treated by surgical, medical, or other special procedures. This has enabled us to note the results of treatment of all kinds administered by others and has permitted a comparison with that which we have been able to initiate. In reviewing the breast cases seen in the Radiation Therapy Department over a period of twenty years we have undertaken to evaluate some of the procedures employed and to give the statistical data upon which we base our findings. Because of the economic instability of most patients seeking charitable medical care, follow-up has not always been possible, nevertheless, in spite of difficulties, we have been able to keep under surveillance a large number of cases for a long period.

Our patients are divided into three large groups, those who come directly to Bellevue Hospital for a primary breast condition, those referred by other hospitals or physicians for irradiation following surgical procedures, or for irradiation for recurrences or metastases, those sent for custodial care.

In 1933 we reported (1) on 230 breast cancers treated in the Radiation Therapy Department of Bellevue Hospital up to

<sup>1</sup> From the Radiation Therapy Service, Bellevue Hospital, New York, N. Y. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

<sup>2</sup> Director, Radiation Therapy Department, Bellevue Hospital, Clinical Professor of Surgery, New York University College of Medicine.

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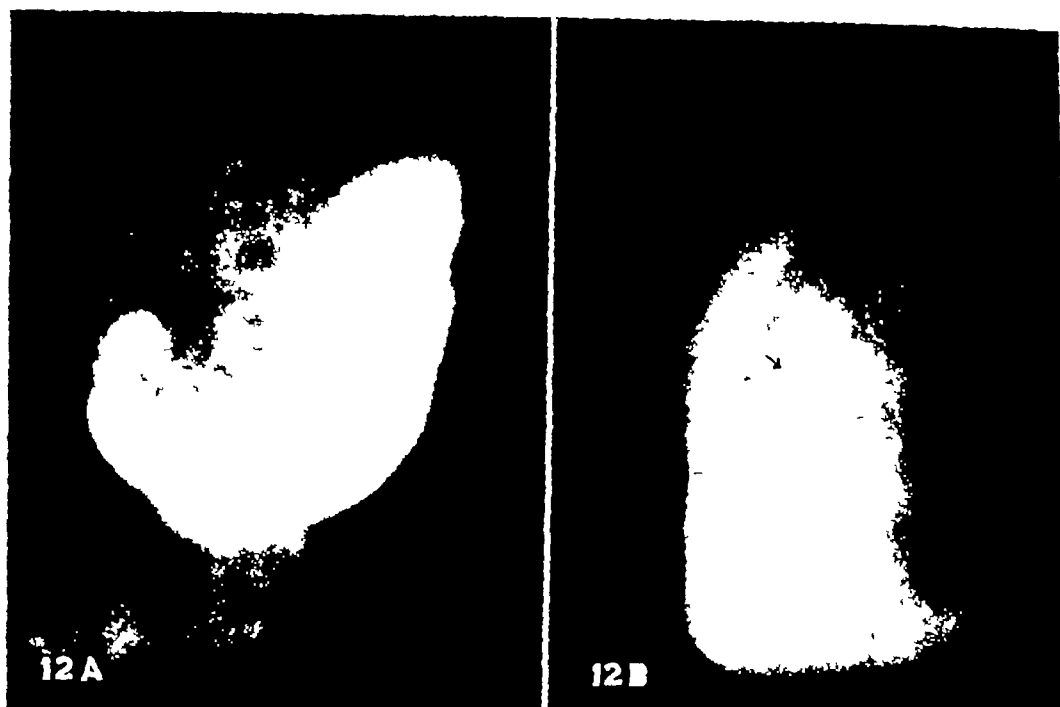


Fig 12 A Anterior view of the stomach and duodenum showing no deformities in the contour  
 B Right lateral view, showing a small niche at the base of the bulb

frontal projection. For this reason, the lesion is often entirely obscured from sight. Several cases (Figs 10-12) are presented showing this type of bulb.

In Figure 10, the anterior view (A) shows a bulb which is well outlined, without the slightest evidence of a lesion. In the right lateral view (B), however, the bulb presents a marked deformity in its proximal portion, with a large ulcer crater.

In Figure 11, the anterior view (A) shows a well outlined duodenal bulb. In the right lateral view (B) a marked deformity in the contour of the bulb is demonstrated.

In Figure 12, the anterior view (A) shows a normal stomach and duodenum. In the right lateral view (B) a very small

niche is seen arising from the base of the bulb.

#### CONCLUSION

The fluoroscopic and roentgenographic study of the stomach and duodenum in the right lateral horizontal position has proved to be useful in arriving at a more accurate knowledge of the condition of the duodenum than can be obtained from the frontal projection alone. The fundamental principles underlying this technic are sound and the procedure can be carried out without the complicated devices which have been introduced for the demonstration of gastroduodenal lesions.

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 Cincinnati 2, Ohio

waiting period, as this gives the malignant tissues opportunity to recover from the effects of the radiation. It is our opinion that preoperative irradiation, surgery, and postoperative irradiation gave the best results. Of the 82 patients receiving such treatment, 19 are known to be dead, 31 were alive after five to fourteen years. The known survival periods were

	Cases		Cases
1 year	28	8 years	2
2 years	10	9 years	4
3 years	7	10 years	2
4 years	6	11 years	1
5 years	6	12 years	2
6 years	7	13 years	1
7 years	5	14 years	1

There is no doubt that postoperative irradiation is indicated in all cases and in some it is unquestionably more than a palliative measure. As Gratzek and Stenstrom (2) have also demonstrated in their study of 731 patients seen over a long period of time, immediate irradiation following radical mastectomy gives the best results. With a short interval between operation and irradiation, they believe there is a lessened opportunity for renewed activity of residual carcinoma. They do not accept the statement of others that radiation is responsible for swelling of the arm following radical mastectomy. This, they assert, is due to scarring and secondary infection incident to the operation, and in some instances to metastases. Lung fibrosis can be minimized by employment of a suitable technic. Pettit (3) also advocates x-ray therapy properly administered and in sufficient dosage as a valuable adjunct to operation. He states that most patients with cancer of the breast have axillary metastases even though these are not palpable, and stresses the importance of technic, skill, diligence, and good equipment in radiotherapy as well as in surgery.

Peters (4) regards preoperative irradiation as of distinct value in the treatment of breast cancer, particularly in stage II lesions. Gylstorff-Petersen (5) also considers preoperative x-ray therapy of real

worth, regarding it as preferable to post-operative treatment. In his observations at the Radium Center for Jutland he found that irradiation with mastectomy and axillary dissection provided the best results. Nohrman, reporting from Borås, Sweden, is another advocate of the combined treatment, which was more successful than either irradiation or surgery alone, even though palpable lymph nodes were present in the axilla.

The type of operation performed in our series of cases varied considerably depending upon the surgeon and the institution in which the patient had been previously treated. Many types of radical procedure were represented, some extremely extensive and others almost classifiable as simple removal of the breast, superficial muscles, and palpable nodes. In 395 cases the record showed "radical surgical removal." Secondary operations were done in 8 cases.

The pathological report was not always specific, being limited in some cases to the mere designation of carcinoma. Pathological grouping was as follows

	Cases
Known pathologic type	546
Unknown pathologic type	135
Pathology not recorded	152

Five cases of sarcoma were included, all far advanced when referred for x-ray therapy. Treatment in these cases was palliative and resulted only in amelioration of symptoms and easing of the final agony.

The following pathological types were seen (the designations are those employed by the various pathologists and are not the authors')

- Adenocarcinoma
- Duct-cell carcinoma
- Scirrhous carcinoma
- Medullary carcinoma
- Colloid carcinoma
- Papillary carcinoma
- Cystic carcinoma
- Mucoid carcinoma
- Plexiform carcinoma
- Squamous cell carcinoma
- Carcinoma simplex
- Transitional carcinoma
- Sarcoma

1930 This report covers an additional 603 cases bringing the total for a twenty-year period to 833. Only those cases accepted for treatment are reviewed. A large number, too far advanced for any but custodial care, are not included in this study. In our evaluation of treatment as we advocate it, we have based our opinions primarily upon 82 patients seen by us before any form of therapy was instituted, whose treatment we were able to direct throughout their entire illness.

Because New York City has a large Negro population, we would expect to find a large number of Negro patients included in this series. Actually, however, only 10 per cent of those treated, namely 83, were Negroes. There were 674 white patients, 2 were of the yellow race, and in 74 cases the color was not recorded. One hundred and sixty-three of the patients were Jews. While breast cancer is predominantly a disease of the female, our series includes 19 males. Most patients were in the 40 to 60-year age group.

	Cases
20 to 30 years	19
31 to 40 years	153
41 to 50 years	259
51 to 60 years	214
61 to 70 years	153
71 to 80 years	36

The marital status of the patients was as follows:

Females (814)	
Single	122
Married	692
Males (19)	
Single	2
Married	17

Of the married women, 501 had had one or more pregnancies, 2 of the single women had borne children. In most instances only one breast was involved, the right in 416 cases and the left in 372. The disease was bilateral in 45 cases.

As to the effect of lactation on cancer of the breast, we found little difference between women who nursed their children and those who did not. The practice or non-practice of child nursing was recorded

in 583 cases. In 440 of these lactation occurred.

Trauma was not frequently reported in our cases, and only 59 patients mentioned it as a possible causative factor. We did not notice that concurrent disease played a very important role; there were recorded only 74 cases with some associated disease process. Diabetes was recorded in only 5 cases, and in these the cancer was of slower growth.

Classification of cases was along clinical lines and depended on conditions present as observed by us. There were 181 cases of Grade I, with involvement limited to the breast and with no axillary or other appreciable metastases, 452 cases were of Grade II, having a breast tumor with appreciable axillary metastases, 203 cases were of Grade III, with axillary and supraclavicular adenopathy, 170 cases were of Grade IV, having involvement of other areas, skeletal or visceral, Grade V included 23 cases with extensive generalized involvement. There were 42 cases of the *en cuirasse* type. Of 151 patients referred from other hospitals, 49 were without appreciable metastases, 95 showed local adenopathy and 2 generalized metastases.

There were 5 cases of breast cancer with associated pregnancy, and in 3 cases the breast lesion developed immediately after pregnancy, 1 patient had recurrence and metastases following pregnancy after treatment of the breast condition had been carried out.

Treatment of all cases was individualized and varied according to the type and extent of the lesion and the condition of the patient. Treatment methods were also dependent upon whether irradiation was preoperative, postoperative, or palliative.

We have advocated preoperative x-ray therapy in all cases but have not always been successful in inducing the surgeon to accept this recommendation. By preoperative x-ray therapy we mean giving an appreciable amount of radiation to the breast and surrounding areas within three weeks prior to surgical removal of the breast. We do not advocate a longer



waiting period, as this gives the malignant tissues opportunity to recover from the effects of the radiation. It is our opinion that preoperative irradiation, surgery, and postoperative irradiation gave the best results. Of the 82 patients receiving such treatment, 19 are known to be dead, 31 were alive after five to fourteen years. The known survival periods were

	Cases		Cases
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The following pathological types were seen (the designations are those employed by the various pathologists and are not the authors')

	Cases
Adenocarcinoma	179
Duct-cell carcinoma	286
Scirrhous carcinoma	40
Medullary carcinoma	10
Colloid carcinoma	2
Papillary carcinoma	6
Cystic carcinoma	1
Mucoid carcinoma	1
Plexiform carcinoma	3
Squamous-cell carcinoma	6
Carcinoma simplex	6
Transitional carcinoma	1
Sarcoma	5

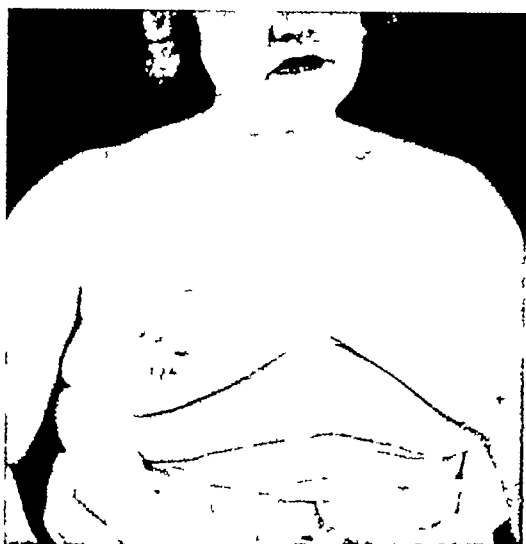


Fig 1 Cancer of the breast, proved by biopsy, treated solely by radium and x-rays. Patient alive and clinically free from cancer nine years after treatment.

Bone metastases were discernible in 255 cases, the most frequent sites being the spine (49 cases) and the pelvis (48 cases). In many cases there was more or less generalized skeletal involvement. Treatment for bone metastases depended on their extent. For single lesions, treatment was given directly over the affected area, generalized lesions were treated through large portals. The radiation dosage was determined by the purpose of therapy, whether palliative, for relief of pain, or curative. In most instances, even when involvement was extensive, pain was relieved and in many cases healing of the lesion with recalcification was demonstrable on the roentgen film. In cases of bone metastases with pathological fracture, supportive plaster casts were employed and x-ray therapy was administered through these with good results. Healing of fractures following irradiation was often evident roentgenographically.

Lung metastases occurred not too frequently in our series and always marked a poor condition. Irradiation through the lung proved of value for relief of pain, discomfort, and cough but did not control the disease or appreciably prolong life. Pleuritic complications required treatment

in the usual manner, including paracentesis for fluid removal when indicated. Liver metastases were always a grave complication and when associated with ascites affected the prognosis unfavorably. Irradiation directly to the liver in some cases ameliorated symptoms, but the ultimate rapid down-grade course was not appreciably arrested. When ascites was present, paracentesis was carried out before irradiation. Cranial metastases occurred in but few instances and irradiation to the skull often alleviated the symptoms from such involvement.

In some cases, because of the patient's unwillingness to permit surgical removal of the breast, or conditions not permitting radical surgery, irradiation alone was employed in the treatment of the breast cancer following biopsy (Fig 1). There were 165 cases in this group.

#### TREATMENT

The types of irradiation included x-ray therapy, radium pack therapy, interstitial therapy, and combinations of these modalities. Surgery was employed as a radical measure for removal of the breast, as a palliative procedure for removal of a foul, unhygienic tumor, for secondary dissection of movable axillary or other recurrent masses, and for removal of isolated local metastases. As a rule, for preoperative and postoperative irradiation, high-voltage x-rays—200 kv, with 0.5 mm Cu, 1.0 mm Cu, or a Thoraeus filter—were used. The plan of treatment was outlined in accordance with the requirements of the individual case. The dosage depended upon the size of the lesion, age of patient, and presence or absence of metastases. Preoperative therapy was usually administered over ten consecutive days, directed to the breast and anterior chest wall, the axillary and supraclavicular and the post-axillary areas. Postoperative therapy was administered at a slower rate, the amount and direction of treatment being influenced by the condition presented. In some cases of local recurrence and in lesions of the *en cuirasse* type, low-voltage or contact x-ray therapy

was used. Results have not been uniform in such cases. Occasionally local radium has been applied to small recurrences. Contact therapy has given good results, in some instances better than those obtained by other methods.

The effect of irradiation on lymph node metastases has not been satisfactory. Disappearance of already established nodes seldom followed any form of therapy, though occasionally regression of axillary nodes was observed with high-voltage irradiation. Relief of symptoms was often obtained, but supraclavicular lymph node involvement was infrequently affected by the usual form of irradiation. It was in the supraclavicular metastases that we noted the definite value of treatment with the 5-gm radium pack. Often such metastases completely regressed with this type of radium therapy. Cases with fixed lymph node metastases were considered to offer a poor prognosis.

It has long been known that ovarian sterilization has aided in the control of breast cancer and that orchietomy has accomplished similar effects in some males with cancer of the prostate. In view of this, an attempt was made by Farrow (7) to secure similar control effects in male and female patients with skeletal metastases from breast cancer, by the administration of estrogenic or androgenic substances. He concludes that it appears that estrogens and androgens have a similar effect on skeletal metastases from mammary cancer. There is evidence that there is some growth inhibition in certain cases following withdrawal of either of these hormones and conversely an excess of either accelerates the rate of malignant growth. Farrow calls attention again to what we have often reiterated: that hormone therapy is to be employed with care in cases of carcinoma. The question of giving estrogens to post-mastectomy patients with menopausal disturbances is of importance, for one must recognize "the possibility of activating quiescent and unrecognized foci of metastatic cancer. In general it would be much safer to forbid pregnancy or the use of

estrogens in all cases of mammary cancer for at least five years or preferably longer."

Treves (8) also calls attention to the danger of promiscuous use of estrogens, especially in breast cancer. He condemns their employment to inhibit osseous metastases from mammary cancer as an unwarranted and dangerous procedure, since it stimulates their growth. "The use of androgens to check secondary bone deposits in breast carcinoma in women is an especially bad therapeutic measure." These pronouncements are in accord with the judgment of most informed clinicians who have had the opportunity of observing large groups of breast patients.

Prudente (9), however, states that the prophylactic use of androgens following surgery is of definite value in mammary cancer. He believes that "testosterone propionate exercises a protective or prophylactic action against recurrence of surgically treated mammary cancer." He advocates the use of testosterone even in women past the menopause. Although at first this seems absurd, "one must realize," he says, "that even in elderly women suffering from cystic mastopathia estrogen is found in the breast." In spite of Prudente's favorable reports, the consensus among informed therapists is that androgen therapy in breast cancer is not an effective or proper procedure. In a recent personal communication, however, Adair stated that with the use of massive doses of androgens favorable results are now being noted in some cases. Our results with androgens as yet have not been favorable.

Hochman (10) contends that carcinoma of the male breast is not autonomous and that it cannot be histologically distinguished from the same ailment in the female. "Yet, the etiology of the male breast cancer must clearly be distinct from that of the female breast cancer with regard to all aspects which depend on the function of the mammary gland and perhaps also those which depend on its endocrine regulation." In his series, male breast cancer accounted for 1.65 per cent of the cases. Combined surgery and radi-

ation therapy produced satisfactory results in 9 of the cases treated

What influence elimination of the gonadotropic hormone has on the growth of breast cancer in the male was investigated by Treves and his associates (11). They studied the effect of orchiectomy on 6 men with cancer of the breast with bone metastases. In the older patients, removal of the testes gave definite relief from pain. In 2 cases, regression of the primary lesion occurred along with restorative effects on skeletal metastases. In the case of a young man no favorable result was achieved, which seems to bear out the general feeling among clinicians that young people suffering from cancer do poorly under any form of therapy.

Regarding the effect of castration upon inherited hormonal influences, Smith (12), studying breast tumors in mice, found it apparent "that there is a relationship between the incidence of breast tumors in mice and the degree of hormonal stimulation. The development of mammary cancer in virgin females of cancerous strains has been demonstrated to be partially dependent upon inherited character. This inherited hormonal influence may also be responsible for the adrenal cortical hyperplasia in castrated mice. The adrenal changes are apparently followed by hormonal stimulation of the uterus resulting in estrus, mammary gland development with precancerous nodules, and eventually the appearance of mammary tumors in those animals with the active milk agent. In the castrated animals without the active milk agent there were adrenal changes but precancerous lesions and mammary tumors have not appeared. Castrated animals having the milk agent but not the inherited hormonal influence may show modified adrenal changes but no other evidence of hormonal stimulation." It will be of interest to discover whether such findings apply to human breast cancer as well.

The question of what to do in breast cancer complicated by existing pregnancy is still a moot one. There were 5 cases in

our series. We have felt that in such an event interruption of the pregnancy before the fourth or fifth month is a necessity if the cancer is to be controlled. We doubt whether any measure of treatment after the fifth month will prove effective. These patients are permitted to go to term, while the breast is treated by x-ray and simple mastectomy followed by postoperative x-ray and subsequent radical surgery as the condition may warrant. Castration is then insisted upon to prevent further pregnancies and to reduce, if possible, any potential metastatic development or recurrence.

At present it is an almost universal belief that all patients with breast cancer and bone metastases who have not reached the menopause should have ovarian sterilization whether by surgery, as suggested by Horsley (13), or by irradiation as advocated by radiologists. One cannot be certain, however, that such therapeutic procedure will affect the primary cancer growth or prevent the appearance of metastases, though clinically such effects have been observed in some cases.

Because of the effect of estrogens on cancer, we have advocated sterilization of young women with breast cancer and have carried out this procedure in every case permitting it. Sterilization suppresses the menstrual function and related estrogenic action. Furthermore, pelvic x-ray irradiation, the method used by us, has a favorable general effect on the body and helps to heal and inhibit the formation of skeletal metastases. In substantiation of clinical observations made over a course of years, Adair *et al* (14) report that in their experience castration materially improves results in cancer of the breast.

Whether radiation sterilization should be limited to younger women with breast cancer is still a disputed question. Pomerooy (15) administers ovarian irradiation irrespective of age. "We have done this," he says, "because we have not known at what age to withhold treatment and because ovarian irradiation adds only a few days to the usual postoperative x-ray

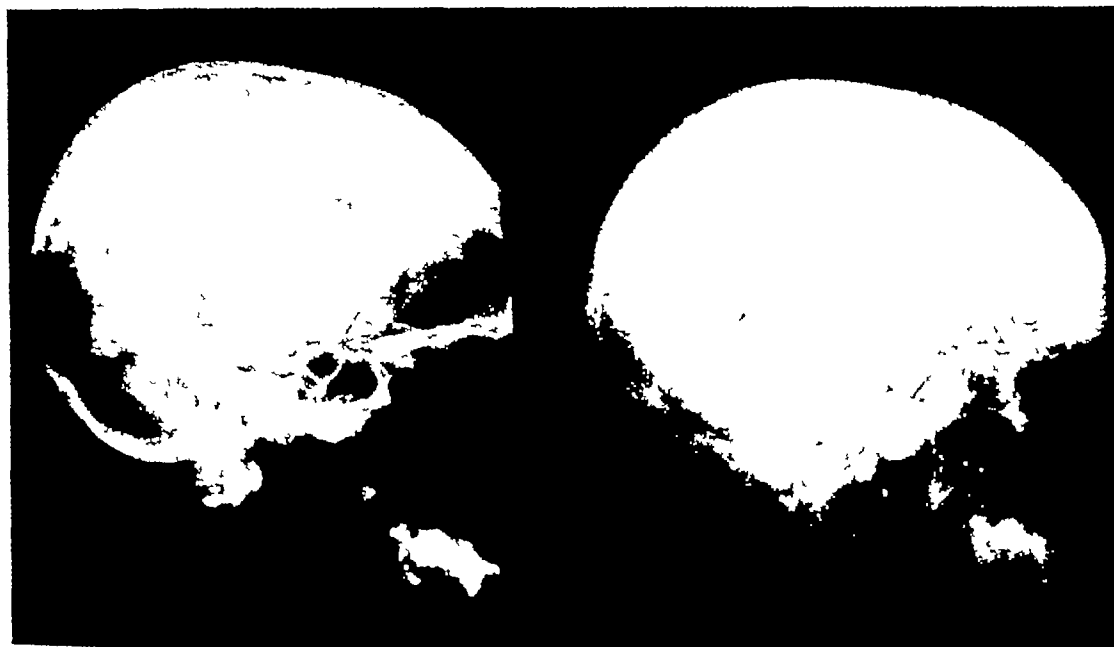


Fig 2 Skull metastasis from cancer of the breast before and after sterilization by x-rays



Fig 3 A Swelling of the arm and recurrent tumor following operation for cancer of the breast B Same patient following x-ray treatment

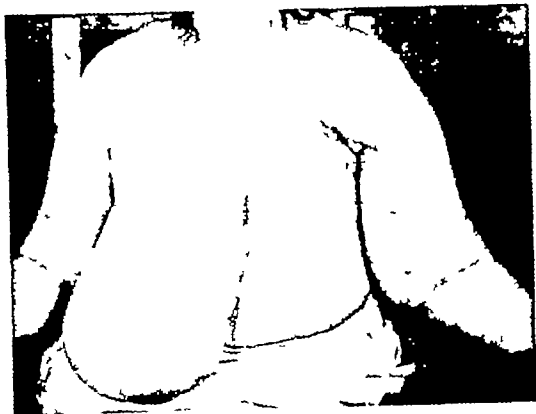


Fig 4 Swelling of the arm following operation for cancer of the breast



Fig 5 Advanced cancer of the breast treated by irradiation and surgery A Before treatment B After preoperative irradiation, surgery, postoperative irradiation, and skin grafting

series." We also believe that in addition to suppressing menstrual function, and thus reducing the hormone effect on cancer, x-rays produce a general effect on the tissues themselves which tends to control metastatic conditions (Fig 2).

We have in some cases treated women past the menopause, with the idea that there may be residual estrogenic activity in the ovaries which will be suppressed only by castration.

Carcinoma of the ovary was associated with breast cancer in 8 cases in our series. What significance the ovarian cancer had in the formation of the breast cancer is not clear. We have held that estrogenic action

may be carcinogenic in its effect on the breast and for that reason have advocated sterilization. With cancer already in the ovary, what is the effect on breast cancer? Judging from our cases, this is still a question. Hormone medication had scant effect on the formation of breast cancer as far as we could determine from those cases in which such medication had been employed before the patients were seen by us.

Complications were noted in some instances. Postoperative swelling of the arm was not infrequent, varying from a mild, soft swelling to extensive distortion and fixation of the arm (Fig 3). We do

not believe that irradiation was responsible in our cases for this occurrence. In our opinion destruction of the lymph and venous channels was the most logical explanation (Fig 4). In cases where stripping of the brachial vein was done during the axillary dissection, swelling most frequently followed. X-ray therapy availed little for the relief of this condition, but early postural changes and massage sometimes helped. Recently a surgical lymph drainage procedure carried out by Dr Samuel Standard of the Third Surgical Service at Bellevue Hospital has given amelioration of this disturbing complication in some cases.

Pneumonitis occurred in only 4 patients irradiated by us. This we attribute to our technic—avoidance of direct therapy through the chest and the persistent use of tangential irradiation. In cases in which treatment had been given elsewhere, additional therapy, even tangentially administered, was apt to increase the possibility of this complication or to accentuate an already present pneumonitis.

In some cases the breast lesion consisted of a bulky, ulcerated mass for which radical surgery was contraindicated. In these cases x-ray therapy sometimes controlled the ulceration, shrank the tumor, and led to local healing. In other cases following irradiation the local condition became operable and subsequent surgery was possible (Fig 5). In still others, in spite of all treatment, ulceration and necrosis continued, with persistent cachexia and death (Fig 6).

RESULTS

Of the 82 patients treated by preoperative irradiation, surgery, and postoperative irradiation, followed for a period of five years, 31 are known to be alive and 19 are known to be dead (see page 585). Longevity records for the entire group of 833 cases are appended. 749 cases were followed up to 5 years, 84 patients lived beyond the 5-year period.

Longevity Record	
1 year	447
2 years	155
3 years	73
4 years	46
5 years	28
TOTAL (1 to 5 years)	749
6 years	23
7 years	13
8 years	6
9 years	7
10 years	8
11 years	8
12 years	4
13 years	4
14 years	7
16 years	2
17 years	1
21 years	1
TOTAL (6 to 21 years)	84

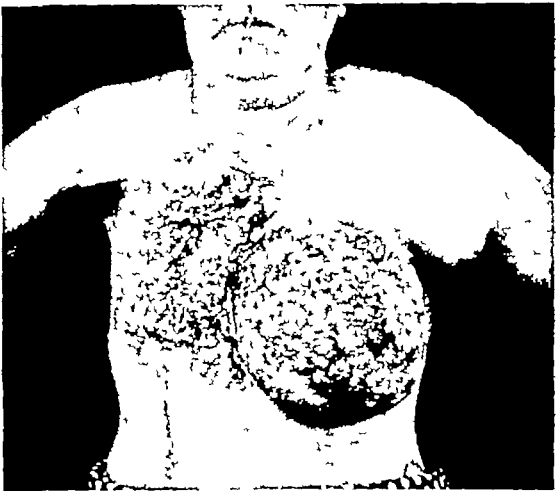


Fig 6 Advanced cancer of the breast uncontrolled by surgery and irradiation

CONCLUSIONS

- 1 Irradiation is a valuable adjunct to surgery in the treatment of breast cancer. The best results are achieved following early diagnosis, with preoperative irradiation, surgery, and postoperative irradiation.
- 2 For favorable results surgery should follow within three weeks after preoperative irradiation has been administered.
- 3 X-ray therapy administered at any period after surgery is of definite value in alleviating distress and in prolonging life.
- 4 Hormone therapy has proved of little value in the control of breast cancer or its metastases.
- 5 Breast cancer associated with pregnancy offers a poor prognosis.
- 6 Sterilization in young women with breast cancer is definitely advocated.

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Fig 1 Calcified subacromial bursitis. Note large calcified plaques beneath the acromion process, also the osseous bar or partially calcified coracoclavicular ligament, a bilateral anatomic anomaly. Left shoulder. No pain.

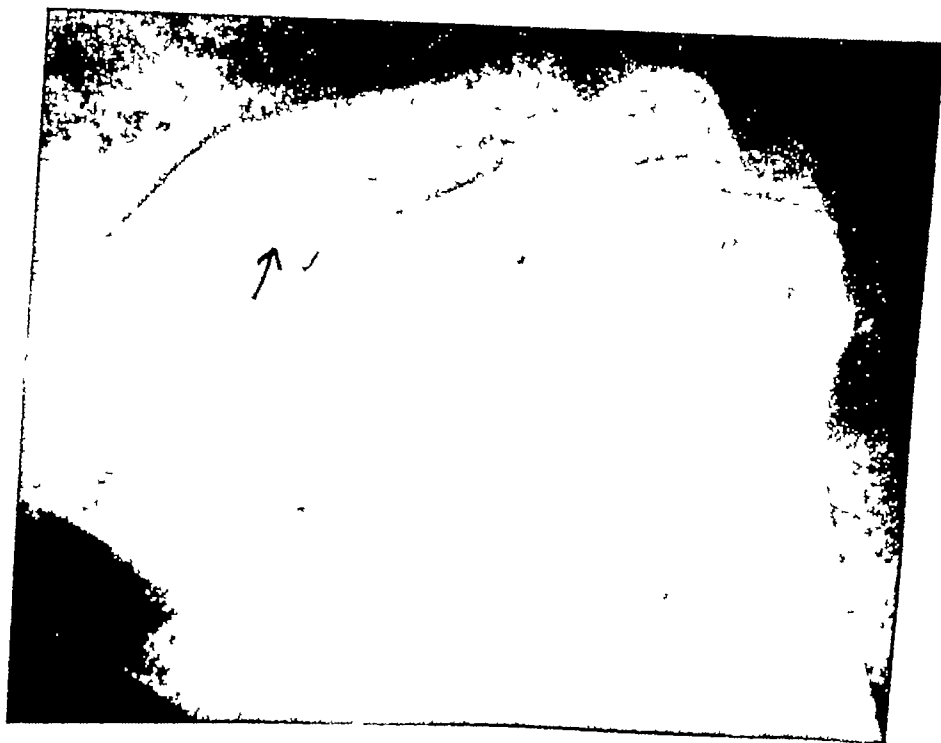


Fig 2 Right shoulder of patient shown in Fig 1. Note the small pea sized calcific deposit in the subacromial bursa, also the anomaly of the coracoclavicular ligament similar to that in the opposite shoulder.



ject, also, to toxic and infectious conditions. To designate the tendinous attachments to the greater tuberosity of the humerus, Codman has used the term "conjoined tendon of the shoulder joint"—the supraspinatus, the infraspinatus, and teres minor. In the erect posture the tendon which initiates abduction—the supraspinatus—functions at such mechanical disadvantage that sudden motions to prevent or guard against blows or falls may result in a partial or complete tear. Other tendinous attachments may be injured or ruptured in fractures of the head of the humerus or the greater tuberosity and adjacent bone, and in dislocations. These tears, whether minute or large, result in laceration of the bursal floor. The sac interposed between the greater tuberosity with its tendinous attachments and the acromion is easily irritated by overuse. These various factors frequently cause the bursa to be crippled by adhesions and result in a state of chronic irritation. In slight injuries to the tendon attachments complete recovery may occur, aided by the education of other muscles to function during the acute stage. With repeated trauma causing more severe injuries, with slight repair, the condition becomes chronic.

**Clinical Picture** In most bursal affections, marked tenderness is common and may be localized very early by touch. The movements characteristically attended by pain are abduction and external rotation of the upper arm. The patient usually raises the arm in a hesitant fashion, with many pauses until it is at or near a right angle to the trunk. So much spasm is present in acute injuries that abduction is prevented and, as the condition becomes older, pain is greatly increased when an attempt is made to raise the arm beyond a right angle. Motion is considerably restricted and there is much crippling. Pain may be so intense as to interfere with sleep and require the use of morphia.

**Roentgen Findings** In minor injuries the roentgenogram affords little or no information. With fractures of the greater tuberosity, or comminuted fractures of the



Fig 3 Subacromial bursitis. Observe the flat, irregular, shallow excavation and straight surface of the greater tuberosity of the humerus. The normal convex surface is absent. The patient experienced acute pain and marked limitation of motion. Roentgen therapy produced dramatic relief. No history of injury. Over two years' duration.

head of the humerus, one must be prepared if symptoms persist, especially pain on motion, to consider the possibility of subsequent involvement of the bursa. The gap in the contour of the greater tuberosity left by a tear of the supraspinatus tendon invariably involves the bursa, and surgical treatment is usually required. Roughening of the surface and irregularities of the bone texture of the greater tuberosity are common findings on the roentgenogram, changes which may be found only in bone, with no calcium shadows apparent in the soft tissues (Fig 1). Later, as the condition grows older, calcium deposits occur in the bursal sac, representing nature's attempt to heal the injury or inflammatory process. These calcium deposits vary in size from fine granules of sand to large irregular calcium deposits which may fill the sac beneath the deltoid muscle and even extend to that portion beneath the acromion process. Not infrequently what may appear to be irregular calcium deposits on

the roentgenogram prove, on aspiration, to consist of fine sand-like particles

A case is illustrated (Figs 1 and 2) in which calcium shadows were present in the subacromial bursa of each shoulder. In the left shoulder, beneath the acromion process of the scapula, was a large oval deposit of calcium measuring  $3.5 \times 1.0$  cm, parallel to the lower border of the acromion (Fig 1). The same patient had an anatomic anomaly of the coracoclavicular ligament. In the outer third of the clavicle, from its lower border, there projected a rectangular shadow of bony density about  $1.5 \times 1$  cm, which appeared to be an exostosis but actually formed a part of the acromioclavicular ligament. This anomaly was present in both shoulders (Figs 1 and 2).

#### CONCLUSIONS

Shoulder injuries in which the subacromial bursa is involved are relatively common. The presence of calcareous de-

posits in the soft tissues, from the acromion process to the greater tuberosity, usually form the main criterion for an x-ray diagnosis. To these may be added changes in the surface of the greater tuberosity of the humerus—excavations, deep or shallow, of varied size, and thickening of the cortex or periosteum. One must keep in mind calcareous shadows lying closely adjacent to bone which partly conceal the deposits. Stereoscopic views and oblique projections may be necessary for their better visualization. Incidentally, in many cases roentgen therapy directed to the bursa will relieve the acute pain in dramatic fashion.

6060 Drexel Ave  
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# Significance of Calcification for Roentgen Diagnosis of Aneurysm of the Abdominal Aorta<sup>1</sup>

EDMUND W KLINEFELTER, M D

York, Penna.

OVER 1,000 cases of aneurysm of the abdominal aorta have been recorded in the medical literature but, though roentgen examination is generally recognized as of first importance for the diagnosis (10, 13), comparatively little space has been devoted to that phase of the subject

organ displacement (5), and calcification (11), with the chief stress on vertebral erosion and practically no consideration of the characteristic calcification. No details were found concerning the differentiation of the calcification of an abdominal aneurysm from that of the common



Fig 1 Roentgen appearance of the characteristic calcification of aneurysm of the abdominal aorta, a single curved line of coarse calcifications in the neighborhood of the vertebral column with its concavity directed toward the column. The greater portion of the aneurysm wall is ill defined because of indistinct calcifications. In contrast to this calcification, that of the common calcified aorta tends to outline the length and width of the structure through the major part of its abdominal course. A Case I B Case II

Actually, the roentgenologist fails to make the diagnosis in 80 per cent of cases despite the presence of adequate evidence on the film (3). Diagnostic criteria which have been mentioned include vertebral erosion (1, 16), presence of a soft-tissue mass (6),

calcified aorta which is the most frequent source of confusion.

Three proved cases of aneurysm of the abdominal aorta recently studied by the writer illustrate the characteristic calcification. One patient had a ruptured aneu-

<sup>1</sup> From the Department of Radiology, York Hospital, York, Penna. Accepted for publication in December 1945

the roentgenogram prove, on aspiration, to consist of fine sand-like particles

A case is illustrated (Figs 1 and 2) in which calcium shadows were present in the subacromial bursa of each shoulder. In the left shoulder, beneath the acromion process of the scapula, was a large oval deposit of calcium measuring  $3.5 \times 1.0$  cm, parallel to the lower border of the acromion (Fig 1). The same patient had an anatomic anomaly of the coracoclavicular ligament. In the outer third of the clavicle, from its lower border, there projected a rectangular shadow of bony density about  $1.5 \times 1$  cm, which appeared to be an exostosis but actually formed a part of the acromioclavicular ligament. This anomaly was present in both shoulders (Figs 1 and 2).

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Fig 2 Case 1 Barium enema study showing filling defect at upper end of rectum due to blood clot from a ruptured aneurysm. This defect resembles closely that from carcinoma but differs from carcinoma by the presence of an underlying intact mucous membrane. The appearance of such a filling defect in a patient with the characteristic calcification of an abdominal aneurysm should suggest the possibility of rupture of the aneurysm.



Fig 1, C Calcification of aneurysm of abdominal aorta See also Fig 1, A and B

rysm and showed a rectal filling defect from a blood clot, detectable by barium enema Attention, therefore, is called to the possibility of the existence of a ruptured aneurysm when the characteristic calcification and a rectal filling defect appear in the same patient

#### REPORT OF CASES

CASE I A D, an obese 69 year-old white male with hypertension, had been complaining over the past six months of intermittent abdominal pain somewhat more severe in the right lower anterior quadrant Recently the pain had become worse and the patient was hospitalized with a tentative diagnosis of intestinal obstruction

A plain film of the abdomen on the day of admission showed a distinct curved line of calcification on the right side of the vertebral column which at first was thought to represent the right border of a calcified aorta (Fig 1, A) Closer inspection revealed an indistinct interrupted line of calcification opposite the distinct line, completing the outline of a fusiform aneurysm

A barium enema the same day disclosed at the upper end of the rectal ampulla on the right a sharply demarcated filling defect, 2 cm in length, with an

essentially intact underlying mucous membrane (Fig 2)

Three days after admission a surgical consultant suspected appendicitis and at laparotomy uncovered a ruptured aneurysm with retroperitoneal hemorrhage and clotted blood producing the rectal filling defect Section three days later confirmed this observation

CASE II J C, a slender 70-year old white male with hypertension, suffered for three years prior to death from carcinoma of the prostate, which in the process of growth invaded the bladder and caused obstruction of the ureters Physical examination one year before death disclosed in the upper abdomen, slightly to the left of the vertebral column, an expansile pulsatile mass the size of a grapefruit Plain films of the abdomen taken four days before death showed a distinct curved line of calcification to the left of the vertebral column corresponding to the palpable mass (Fig 1, B) Death was due to uremia Section showed an unruptured saccular aneurysm corresponding to the physical and roentgen findings

CASE III M L, a slender 76-year-old white male, with hypertension, suffered from angina pectoris for the last six years of his life Eight months prior to death a coronary occlusion occurred At this time physical examination disclosed in the mid-abdomen, slightly to the left of the vertebral column, an expansile pulsatile mass the size of an orange One month prior to death the patient complained of intermittently passing bright red blood by rectum, which was attributed to hemorrhoids found by proctoscopic examination A barium enema at this time showed a normal colon and a curved line of calcification to the left of the vertebral column corresponding to the palpable mass (Fig 1, C) Death from coronary occlusion followed ten days after the barium enema study Section showed an unruptured saccular aneurysm corresponding to the physical and roentgen findings

*Epitome of Cases* The three patients were all males over 65 years of age, who for years had performed heavy manual work All suffered from chronic hypertension and far advanced arteriosclerosis A definite expansile, pulsatile mass along the course of the aorta was present in two of the cases The patient in whom rupture occurred was too obese for satisfactory palpation In this case shock, abdominal rigidity, and signs of internal abdominal hemorrhage were not noted until after operation It is possible that rupture with repeated small hemorrhages dated from the onset of

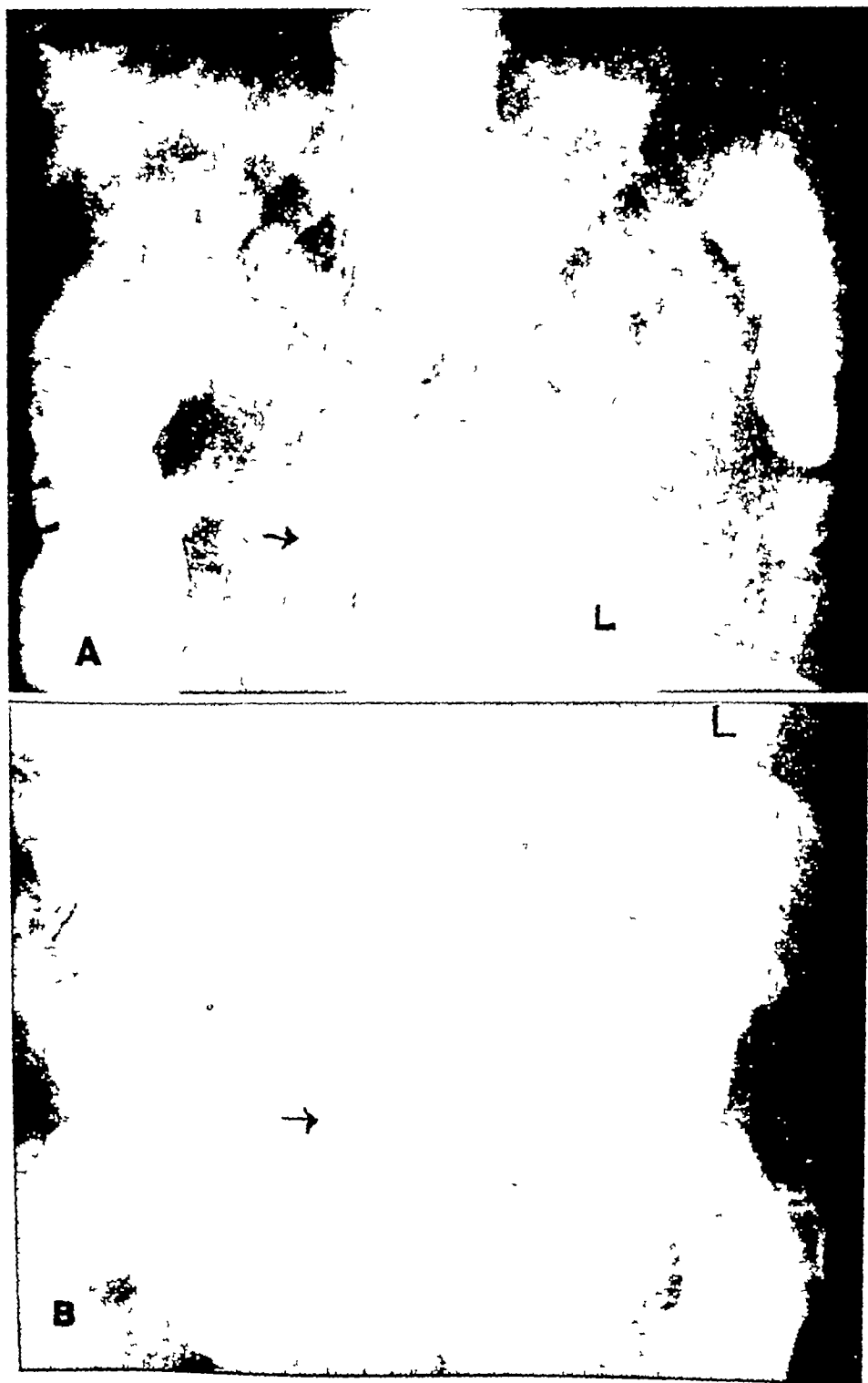


Fig 2 Case 1 Barium enema study showing filling defect at upper end of rectum due to blood clot from a ruptured aneurysm. This defect resembles closely that from carcinoma but differs from carcinoma by the presence of an underlying intact mucous membrane. The appearance of such a filling defect in a patient with the characteristic calcification of an abdominal aneurysm should suggest the possibility of rupture of the aneurysm.

pain six months prior to death. Nerve root irritation from the hemorrhage probably accounted for the pain, which simulated that of appendicitis. Erosions of the vertebrae were not demonstrated in any of these patients.

#### COMMENT

*Relation of Arteriosclerosis to Abdominal Aortic Aneurysm.* Authorities are agreed that the cause of abdominal aneurysm is in most cases arteriosclerosis and not

no details are furnished, and no mention is made of the fact that in most cases the true nature of these calcifications is not recognized. Very rarely calcifications completely outline the aorta and the aneurysm as an opaque mass, rendering the diagnosis easy (4). In the great majority of cases, however, only a portion of the aneurysm wall is outlined on the film by a single curved, continuous or broken, line of calcification, while a considerable portion of the wall is ill-defined because of

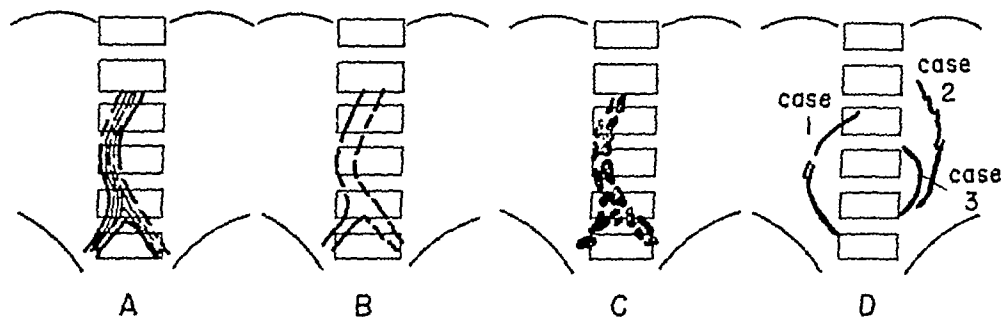


Fig 3 Characteristic calcifications of the abdominal aorta tending to outline the length and width of this structure through the major part of its abdominal course. A Type 1, most frequent type, appearing as a band of diffuse calcification with denser lines of calcification marking the width. B Type 2, appearing as a radiolucent band with dense lines of calcification marking the width. C Type 3, scattered patches of calcification with no parallel lines marking the width. D Tracings of the single curved lines of calcification of the 3 aneurysms studied by the writer. Compare this calcification with that of the aorta in tracings A, B, and C.

syphilis, which is in contrast to aneurysm of the thoracic aorta (12, 15). Since arteriosclerosis is largely a disease of old age, the possibility of aneurysm must be considered in every elderly patient with sclerotic blood vessels, especially males belonging to the laboring class with a long history of hypertension. A ruptured aneurysm must be considered a possibility when there is associated abdominal pain, especially in the back and left upper and right lower quadrants (7). Because so many people now are living into the years when arteriosclerosis is common, abdominal aneurysms are more frequent and it is correspondingly important that the roentgenologist be able to recognize them (3).

*Characteristic Calcification of Abdominal Aortic Aneurysm.* In their discussions of abdominal aortic aneurysm Roesler (14) and others (9) state that the plain film almost invariably reveals calcifications, but

indistinct calcifications which require for their detection very close inspection, frequently of multiple films taken in various projections (Fig 1, A, B, and C). Such a unilateral distinct line of calcification, often sharply curved, located either to the right or left side in the neighborhood of the vertebral column, usually with its concavity directed toward the column, is most readily confused with a calcified tortuous aorta (Fig 3). Consequently it is important that the roentgenologist be familiar with the usual appearances of the calcified aorta.

*Characteristic Calcification of the Abdominal Aorta.* A search of the literature revealed no adequate details on the roentgen aspects of calcification of the abdominal aorta. In view of this deficiency, films of 50 patients with calcified aortas were studied and in no case was there found a single curved line of calcification such as was ob-



served with aneurysm. In each instance the calcification tended to outline the length and width of the aorta through the major part of its abdominal course. Three types of appearance were noted. Type 1 (25 cases) was a more or less homogeneous band of diffuse calcification with denser coarse lines of calcification marking the width (Fig 3, A). Type 2 (14 cases) appeared as a more or less radiolucent band with coarse lines of calcification marking the width (Fig 3, B). Type 3 (11 cases) consisted of scattered irregular patches of calcification with no parallel lines of calcification marking the width (Fig 3, C).

*Other Abdominal Calcifications* Other abdominal calcifications, such as the irregular flocculent or granular calcifications in cysts, cystic teratomas, tumors or tuberculous areas in the kidneys, lymph nodes, hematomas, and perirenal and paravertebral abscesses, are usually sufficiently characteristic to offer little diagnostic difficulty.

*Ruptured Abdominal Aortic Aneurysm Indicated by Characteristic Calcification Combined with Rectal Filling Defect* When an aneurysm of the abdominal aorta ruptures, the extravasated blood practically always enters the adjacent retroperitoneal tissue (8). Because of the tamponading effect of this tissue, death may not follow for some time and the retroperitoneal blood, aided by gravity and the anatomical relations of the tissues, tends to flow downward into the lowest readily accessible position in the region of the rectal shelf (2, 3). In this location the blood may clot and produce a filling defect of the rectum detectable by barium enema, as in our Case I (Fig 2). This defect may closely resemble that due to carcinoma but differs in the presence of an underlying intact mucous membrane. The possible significance of such a defect when associated with the characteristic calcification has been mentioned.

#### SUMMARY

(1) Abdominal aneurysms are becoming more frequent but are overlooked in 80

per cent of the cases, largely because their calcification is confused with that of the common calcified aorta. In order to avoid this confusion, attention is called to the distinguishing characteristics of the calcifications of the abdominal aorta.

(2) A case of ruptured aneurysm of the abdominal aorta is reported in which the characteristic calcification was associated with a filling defect of the rectum. Attention is called to the possibility of this combination of appearances indicating the presence of a ruptured aneurysm.

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# Therapeutic Radiology<sup>1</sup>

GEORGE W. HOLMES, M.D.

Boston, Mass

MR PRESIDENT, ladies and gentlemen I was not aware until a few minutes ago that my talk this evening was to be the first of a newly instituted series of Annual Lectures. Had I known, I should have prepared a more formal address. As it is, I shall have to speak to you informally from a few prepared notes.

In 1910 I treated my first patient with roentgen rays. In the thirty-five years since then I have used this method of treatment almost daily. Naturally I have accumulated certain notions and ideas about its value as a therapeutic agent and the way it should be used, some of which I shall try to pass on to you. I shall also suggest some of the problems associated with therapeutic roentgenology and the way the American Board of Radiology has tried to meet them.

In the beginning, I should like to emphasize that what I shall say is often not founded on scientific data and may or may not be anything more than one man's opinion, and must be accepted as such.

The American Board of Radiology was organized in 1934. Between then and the present time there has been a considerable change in the status of radiology as a specialty in medicine, some of the change has been due to the work of this Board. One of the first problems with which the Board was confronted was the selection of candidates for examination. Should any physician who used x-ray or radium, either in diagnosis or therapy, be accepted as a candidate for examination? Or should only those physicians who held themselves out to the public as radiologists be accepted? After considerable discussion, it was decided to confine candidacy to the latter group, since the Medical Practice Act in most states does not limit any

licensed physician, leaving it to his conscience and the malpractice laws to prevent him from ranging too far afield. It seemed to the members of the Board that it could best serve its purpose by limiting its approval to those men who definitely listed themselves as radiologists and in that way claimed special skill in that particular branch of medicine. Though members of other special groups practise radiology to some extent, as part of their specialty, they have their own boards, in an attempt to maintain proper standards, have exercised the responsibility of examining them in their field as well as their own field. The American Board of Dermatology is an excellent example.

Another problem which the Board had to meet was the determination of what constitutes a proper knowledge of radiology. Should arbitrary standards be set up which the candidate must meet in order to pass? Or should the Board base its decision on the result of an examination which the average better-trained roentgenologist could pass? After the Board had been in operation for a reasonable length of time, it was fairly easy to establish standards on this latter basis. That they are high as compared with the knowledge of radiologists as a whole is shown by the fact that, of all the candidates who have taken the examinations, one out of three has failed. Until radiological training in this country raises the general knowledge, it does not seem desirable to place the standards of examination above what they are at the present time.

It was early obvious that there was a need for better training in radiology, and the American Board in co-operation with the American Medical Association has helped to establish residencies in teaching hospitals and to see that these residencies

<sup>1</sup> The first annual Holmes Lecture, delivered before the New England Roentgen Ray Society, May 18, 1945.

meet certain standards At the present time there are slightly over one hundred residencies available This is not enough, but it does show progress

There are many problems, however, that still remain to be solved One of these is what divisions are desirable in the specialty of radiology, and how many types of certificates should be issued? In the beginning, certificates were issued for radiology, roentgenology, diagnostic roentgenography, therapeutic roentgenology, and radium therapy In my opinion, a man who treats with either x-ray or radium should be familiar with both, and should be competent to use both About two years ago, the following recommendation to the American Board of Radiology was made by Dr Douglas Quick, of New York, and myself that the number of certificates be reduced to three (1) radiology, which would include the entire subject, (2) therapeutic radiology, which would include treatment both with x-ray and radium, and (3) diagnostic radiology No action has been taken up to the present, but I still think the recommendation is worth while That is why I have used for the title of my talk "Therapeutic Radiology"

One might question the advisability of treating therapeutic radiology as a specialty Would it be better for all candidates to be qualified in both therapeutic and diagnostic radiology? There is considerable difference of opinion on this question At the University of Upsala in Sweden, under the direction of Professor Gosta Forssell, there is such a division, with a professor at the head of each department In some universities in this country the development has been along similar lines, in others, a strong effort has been made to keep the department under one head My own feeling is that if radiology is to be a real specialty of medicine and is to maintain its standards, it should both diagnose and treat The radiologist who does not treat has not the same standing among the laity as the man who does Patients get to know the man who treats them and look to him for help and advice This not only

tends to raise his status in the community but also gives him a somewhat different status on the hospital staff

On the other hand, the man who does therapeutic radiology alone must of necessity see a large number of patients who are in the terminal stages of disease, and work limited to such a type of practice becomes depressing and discouraging At the present time, the majority of patients treated with x-ray or radium are suffering from some form of malignant tumor The rapid advances in the treatment of infection with chemotherapy have removed most of these cases from the radiologic clinics Similar advances may be made in the treatment of neoplastic disease, and it seems to me unwise for a young man, starting in practice, to accept as his only field of endeavor such a narrow, uncertain field as therapeutic radiology

Let us now consider some of the problems more directly connected with therapeutic radiology Today the roentgenologist has a considerable field from which to select the kind of radiation to be used in a given case, and he has instruments by which the quantity of the radiation of choice can be accurately controlled On what then should his choice be based? There is no difference in the biological effects of the various forms of radiation, and there is no magic in million-volt radiation or in radium Certain fundamentals, however, must be kept in mind The type of radiation selected in a given case should be that which will be most effective in the area to be treated, without injury to normal tissues above or below it One should not use heavily filtered high-voltage radiation in treating a superficial lesion, especially if sensitive or vital tissue lies beneath it In treating nevi which lie over the end of a growing bone, for example, it must be remembered that the amount of radiation necessary to interfere with the growth of the epiphysis is very small Selection of the kind of radiation thus becomes a matter of considerable importance This is also true in the treatment of a lesion within a body cavity,

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There are many other questions which are still unanswered. Should treatment be repeated after palliative results have been obtained with the first treatment? Should the first treatment be planned so that more can be given later, or should the maximum dose be given in the first series of treatments in the knowledge that the course cannot be repeated? Up to the present I have taken the latter stand. Perhaps we would help the patient more, provided he were known to be incurable, if we left him in a condition which would allow repetition of the treatment. As treatment progresses, careful observations of the results should be noted and recorded after the manner of medical progress notes. This is often neglected, though obviously important. Some patients require more, some less, treatment than originally planned.

The presence or absence of infection has an important bearing on the amount of radiation which can be given. If an area is heavily irradiated in the presence of infection, serious trouble may result because of the rapid spread of the infection. For example, in treating cancer of the mouth, all sources of infection should be cleared up before treatment is undertaken. This usually means removal of all teeth in the field to be irradiated. In some cases, therefore, it might be wiser to treat the patient surgically and save the teeth.

Combinations of various methods of irradiation, such as radium and x-ray, or of radiation and surgery, have been widely used in the past and still seem to be quite popular in some clinics. Personally, I prefer to do one thing at a time. If x-ray and radium are to be used, it is better as a rule to begin the treatment with x-ray irradiation, following it by radium to destroy any residual tumor, rather than to start with radium and follow it by x-ray. Where combined radiation treatment is given, it should be under the control of the radiation therapist, and it is probably better for him to do both. He should therefore be familiar with the technic required for the application and insertion of radium, and competent to apply it.

When x-ray therapy is combined with surgery, operation usually precedes irradiation. Theoretically, radiation could be used to reduce the size of a large tumor or to sterilize partially a tumor that is likely to become implanted during operation. This sequence, irradiation followed by surgery, would seem to be desirable in selected cases, but it has received little support from the surgeon. He is, on the other hand, generally quite desirous of having postoperative irradiation given. The literature contains numerous reports showing an increase in the number of five-year cures following this combined treatment, but such increases are actually small, and in many instances the data presented are open to other interpretations. If the general principle is accepted that surgery should not be undertaken unless the surgeon feels reasonably certain that he can remove the tumor completely, and that x-ray dosage of less than 3,000 r will not destroy cancer, it would seem wise to restrict surgery to curable cases. In such cases, where the tumor has been completely removed, radiation should be avoided, since it will only cause serious injury to otherwise normal tissue. If, however, after operation the surgeon is convinced that his preoperative diagnosis as to the extent of the disease was incorrect and that he has left active tumor tissue behind, postoperative irradiation is justified. We should, on the other hand, avoid offering encouragement to the surgeon to operate in the inoperable case in the mistaken hope that later we can destroy any residual tumor that he was unable to remove.

If one reviews the progress made in radiation therapy, one is immediately impressed with the advances in physics and in the variety and accuracy of the equipment now available, but one is equally impressed by the lack of a corresponding advance in the clinical management of the patient. The following case history taken from Williams' *Roentgen Rays in Medicine and Surgery*, published in 1901, is an interesting demonstration of this.

where it is often better to irradiate by the direct application of radium than with x-rays, which must pass through large masses of tissue before reaching the lesion.

The total dosage is another matter of great importance. Probably it is unwise to exceed an erythema dose in treating any non-malignant lesion. Dosage sufficient to cause an erythema will almost invariably result in some skin damage if the patient lives long enough. On the other hand, if the lesion is a malignant one and there is a reasonable chance of cure, one should not hesitate to give a large dose even if permanent damage is likely to result. In cases where cure is attempted, it is well to remember that there are methods of treatment other than irradiation. The radiation therapist should be familiar with these methods and should bear in mind that the mere fact that he can cure the patient by irradiation is not sufficient justification for adopting that method of treatment. Surgical removal, for instance, might offer an equal chance of cure with less risk of permanent damage.

One might ask what is the proper dosage for malignant lesions? A year ago we were shown a group of cases where doses up to 10,000 r had been used, and in some of the group cure of the local disease was obtained. In my opinion, however, a tumor which requires such extreme dosage as this had better be treated by some other means. There seems to be considerable disagreement regarding the minimum dose required to cure a malignant neoplasm. Without doubt there is a wide variation in this dosage. Cures have been reported following doses no larger than 1,000 r, while in other cases failures have occurred with doses as high as 10,000 r. The variation is tremendous not only among different types of tumors but among tumors with the same histologic appearance. In general, it may be stated that up to a certain point increasing radiation produces an increasing lethal effect on malignant cells, beyond that point, additional radiation produces less and less effect. In other words, there are a few cells which are very radioresist-

ant and which persist after the mass of the tumor has disappeared.

It seems to be a generally accepted fact that lymph node metastases from any given tumor are more radioresistant than the tumor itself. If these nodes are deep-seated, there is little likelihood of destroying them with any dose that can be given without irreparable damage to surrounding tissue. Taussig of St. Louis has published a series of cases of carcinoma of the cervix treated by heavy doses of x-ray and radium, in a large number of which subsequent operation disclosed malignant nodes beyond the site of the primary tumor. Meigs of the Massachusetts General Hospital has had a similar experience. Malignant nodes in the pelvis are not destroyed by any radiation that can be safely given.

This statement may not apply to metastases from radiosensitive tumors. That is, if the primary tumor is definitely radiosensitive, it is reasonable to assume that the lymph node metastases are also fairly sensitive, though less so than the original neoplasm. In these cases, therefore, treatment directed toward lymph node metastases is justifiable. Since in many cases the treatment we can offer is palliative only, before deciding on the dosage we must answer the question, whether or not we are justified in subjecting the patient to the discomfort of treatment and the permanent injury resulting from an attempt to cure. Would it not be better in this group to reduce the dose to that which will produce an arrest of growth rather than use one which attempts to eradicate it but is doomed in advance to failure?

We all talk glibly about the "time factor", but do we know anything about it? The time intervals are often determined by the convenience of the patient and the operator. None of us has tried definitely to find out what would happen if a time period were fixed and strictly adhered to. There is no question regarding the importance of the time factor and its bearing on end-results. Because we should know more about it, a fertile field for investigation lies along these lines.

grossly, microscopically, viable cells are still present. With this in mind, I have increased the dose in selected cases, particularly where there was reason to suppose that only one tumor mass existed. In 1940, I treated a patient with such a lymphomatous mass in his abdomen. The abdomen had been explored, and the tumor proved histologically to be a giant follicular lymphoma. It was found to be localized but inoperable. A dose of 1,200 r was given. There has been no further treatment, and at the present time the patient has no complaints and the physical examination is negative. The skin over the area treated is normal. Since this experience, I have used this method in treating similar cases, and I believe the results have been definitely better.

There are certain lesions which it would seem logical to treat with x-ray or radium but in which failure almost invariably results. Among these are carcinoma of the external auditory canal. I have never cured such a case by radiation, and in most of the cases the progress of the disease has been rapid and the result fatal. The only cures on record have been accomplished by radical surgery. I should hesitate to treat such a case with radiation.

Melanotic sarcoma is another disease which does not respond well to irradiation, although there are a number of reports in the literature recommending this form of treatment. In our clinic the surgical results have been most encouraging, and I would not treat such cases with radiation.

Nevi, particularly the so-called birthmark, in small children have been treated with various forms of radiation for many years. They invariably disappear under treatment, but numerous risks are connected with the procedure and moreover, a high percentage of such lesions disappear without any form of treatment. I would warn against exceeding the erythema dose or against treating with any form of radiation when the lesion is situated over the end of a growing bone or about the eye. Some years ago we reviewed all the cases

A large number

of patients returned for observation, none of whom showed any serious injury. The treatment given in this group was a suberythema dose of superficial x-rays, repeated not oftener than every four months. One patient in the group had had two nevi, only one of which was treated, but both had disappeared.

Warts, particularly plantar warts, are easily a source of trouble to the radiologist. The massive doses now generally used in their treatment should, I think, be abandoned. Certainly they should never be repeated over the same area. There seems to be a great difference in the amount of radiation necessary to cause the disappearance of a wart. I have seen warts disappear with a dose of 300 r.

In closing, I should like to leave with you, particularly the younger men, some suggestions regarding the problems which seem to me to need further investigation. The first is the time factor. There is no doubt that this plays a very important part in the end-results of radiation therapy, and yet we know little about it. The problem is a difficult one which will require observations over a long period of time, as well as experimental study. Nevertheless, it should be investigated. The second problem concerns dosage. What dose is necessary to destroy completely radiosensitive tumors such as those in the lymphoma group? Does heavy irradiation promote metastases? Does it produce an immunity to metastases? Some surgeons favor the former theory. The breaking down of a tumor from any cause, particularly if fragments enter the blood stream, might result in metastatic lesions. The majority of radiologists differ from the hypothesis of the surgeons in that they believe that any wandering cells from an irradiated tumor would not have sufficient vitality to produce a new growth. The suggestion has also been brought forward that metastases are actually *less* likely to take place after irradiation. These problems are extremely interesting and should be solved.

Little River Hill  
Belfast, Maine

"CASE 1 H N, a young man twenty-five years old, who had been a patient of Dr H L Burrell, and by him was kindly transferred to my service, gave the following history. He had always been well and strong. Three months ago he noticed a small crusted sore on the right side of the lower lip, which he thought was a cold sore. It, however, kept up a constant scabbing, and slowly grew larger. There was no attendant pain, but it had grown 'fairly rapidly' during the past two weeks. The patient came to the hospital for operation.

"A small bit of the growth was removed and submitted to Professor Mallory, assistant pathologist at the Boston City Hospital, for examination. He reported that the growth was an epidermoid cancer. The lesion on the right half of the lower lip was 1.5 centimetres long and about 1 centimetre wide, it was crusted and indurated. A small gland was felt under the inferior maxilla, just to the right of the symphysis. Recently the patient had complained of some pain in the lower lip near and around the lesion.

"The first exposure to the X-rays was of seven minutes' duration, and the patient was placed about 12 centimetres from the target of the tube. The resistance of the tube was equivalent to 1.5 centimetres of air. During the ensuing week daily exposures of five minutes' duration each were made. All the parts except those immediately around the growth were carefully protected by means of a shield made of tinfoil laid over blotting-paper, as described in the treatment of lupus. At the end of this time the crust came off, leaving a clean base, and the induration had apparently diminished. From this time the treatment was about two minutes daily.

"On the eleventh day from the beginning of the treatment the cancer was smaller, the induration was much less, and cicatricial tissue was forming, especially on the right side of the growth. The opening in the protective shield was then found to be much too large, and a shield with a smaller hole was made and substituted for it. On the thirteenth day the induration had disappeared. On the eighteenth day the lip showed marked improvement, though it had not been as rapid during the past few days as during the first week, therefore the length of the exposures was increased during the next ten days to five minutes daily. From that time the healing made such good progress that the time of treatment was reduced to one minute, and the distance of the tube from the patient was increased to about 20 centimetres. The part was kept clean by means of a solution of peroxide of hydrogen, which the patient applied several times a day. The treatment by the X-rays continued in all for about five weeks, and the latter part of the time it was almost nominal. I wished to keep the patient under observation until complete healing had taken place and be ready to resume it should improvement cease.

"Presumably with this patient healing would have taken place more rapidly had the treatment been a little more energetic. Four photographs (see Figs

223 to 226), two of which show the appearance before the treatment was begun, and two views taken after the healing had occurred, speak for themselves. The enlarged gland could not be felt after treatment."

In what way, if any, did the treatment reported by Dr Williams in 1901 differ from what we are using in the treatment of superficial lesions today? He emphasized careful daily observations and determined the size of each dose by the reactions which occurred. Perhaps he did this better than we are doing now. He did not treat the patient until the diagnosis was established by biopsy. In my opinion, this is a very important consideration and it is not always being observed today. His daily notes are excellent and he accompanied the case with photographs taken before and after treatment. The only thing he has omitted is a follow-up report. Perhaps the time was too short, but certainly follow-up observations add more to our knowledge than any other single factor.

While it is true that any improvement we have made during the forty-four years since Williams' book was published has been largely due to better equipment, there are certain lesions in the treatment of which experience has suggested some definite ideas. We have increased the duration of life, at least in the patient with Ewing's tumor, by making certain that the entire bone is included in the treatment field rather than confining the area treated to the visible portion of the tumor. By the use of supervoltage irradiation we have been able to give doses up to 3,000 r in such cases without producing permanent skin injury, although in some cases muscle atrophy has resulted. The point that I wish to emphasize particularly is, however, that in the treatment of Ewing's tumor the entire bone should be exposed and the dose should be much larger than that customarily given.

It is well known that tumors of the lymphoma group disappear readily with relatively small radiation doses (600 r  $\pm$ ), but there seems to be some evidence that a dose of this size does not destroy all the cells. While the tumor may disappear



sion of everyone who follows our specialty today. My purpose is rather to bring to your attention at least some of the qualities and characteristics of Holmes, his predecessors, and contemporaries, which furnished the dynamic for fifty years of continuous progress in radiology, and to try to evaluate some of the events which contributed to that progress.

I was speaking a moment ago of the vision which could see future possibilities at a time when there was little in the actual conditions to warrant it. This is a common characteristic which shines out like a beacon in the lives of all of the pioneers in radiology. Indeed, it has been a characteristic of pioneers in every field of human endeavor. It is a spiritual quality which often has little perceptible relation to the so-called "stubborn facts of life." One of your own professors of philosophy here at Harvard has expressed this idea in a famous sonnet entitled "O World."

We may say that George Santayana was a philosopher and could be expected to indulge in poetic flights such as the sonnet to which I have just made reference. But whether you call it "faith," as in his sonnet, which Paul defined as the "substance of things hoped for, the evidence of things not seen," or you prefer to name it scientific prescience based on experience and facts already known, or you think of it simply as the driving power of new ideas, it is nevertheless real and is recognizable as an important characteristic not only of poets and philosophers but of leaders in science as well.

Walter Dodd, who was the founder of the Department of Radiology at the Massachusetts General Hospital and the first teacher of radiology in the Harvard Medical School, and whom George Holmes so worthily followed, had faith in the future of the x-ray in medicine when he was still a pharmacist, a faith that drove him through years of hard work to acquire a medical degree and finally led him to a martyr's death at the age of forty-seven.

Francis Williams, another Boston pioneer in radiology, is an illustration of the

truth that the pioneer spirit is a state of mind and has little to do with age. He was forty-three years old when the x-ray was discovered and had already practised medicine for sixteen years, yet he began, within a year after its discovery, to use the x-ray in examinations of the chest. In the years immediately following he practised and preached the value of the x-ray in chest examinations with evangelistic zeal even in the face of doubt and ridicule. In 1901 he published a book of over 650 pages on *The Roentgen Rays in Medicine and Surgery: Five Years of Practical Accomplishment*, which went through three editions. When it is realized that practically all of Williams' work was based upon fluoroscopic observation, the reports of findings and diagnosis in diseases of the chest recorded in his book as judged by our standards of the present day are little less than astounding. It is not generally known that Francis Williams was really the first in the world to examine the human stomach after ingestion of bismuth. This he did on two patients in 1899, using bismuth subnitrate. He was assisted by Walter Cannon, whose classical study of the esophagus had been made in 1898. Williams published a report of his observations in his book in 1901. This, of course, does not detract from the work of Rieder of Munich, who has always been given credit for originating the study of the stomach after ingestion of bismuth, because it was his work which established the examination as a practical method. Rieder's original paper was published in 1904. Bismuth subnitrate was superseded after some years by bismuth subcarbonate, after publication of a paper by Henry Pancoast in 1905, which discussed the poisonous effects of bismuth subnitrate due to formation of nitrates in the gastro-intestinal tract. It was not, according to my memory, until about 1915 that barium sulfate came into general use. The latter had the great advantage of costing about seventeen cents a pound at that time as compared with three dollars and a half for bismuth subcarbonate.

# The First Fifty Years of Radiology in America    The Elements Which Have Contributed to Its Growth as a Medical Specialty<sup>1</sup>

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Washington, D. C.

I AM ACUTELY conscious of the honor bestowed upon me by your invitation to deliver the "Holmes Lecture" this year, and I feel no less acutely my own limitations for such an important task. If, however, you would add to my otherwise limited qualifications an appreciation of Dr. Holmes as a broad-minded physician and teacher of medicine, a profound respect for his ability as a radiologist, and an affectionate esteem for George Holmes as a friend, no one could be more highly qualified than I to be the speaker on this occasion.

Doubtless one of the objects in establishing an annual lecture is to do honor to him to whom the lecture is dedicated and to recall those accomplishments and those qualities of mind and heart which we wish to keep alive and active through the years. Indeed, such a project can be permanently successful only if the accomplishments and the qualities which we honor are realities. Otherwise the lectureship has no sound foundation and our attempts to "do honor" are a mere *tour de force* originating in false personal sentiments.

It is therefore appropriate thus early in the series to consider, even though we must do so briefly, the contributions which Dr. Holmes has made to medicine, and the special abilities and characteristics which have made him a great leader and teacher of radiology, a successful organizer and administrator of a constantly expanding radiological department, a colleague and consultant held in high esteem by all members of the staff and one whose influence extends far beyond the bounds of his own department.

Dr. Holmes' radiological career began in the year 1910, when radiology was still

in the era of the fickle "gas" tube, when roentgenograms were made on glass plates, when the high-tension transformer and the so-called "interrupterless" machine were just coming into use and most radiologists were still dependent upon the induction coil with its maddening electrolytic or mercury interrupter, when the x-ray "department" was a small room or two next to the furnace and water pipes in the basement, or a closet under a stairway, when the "x-ray man" as he was then called, and as he is still designated by thoughtless or discourteous colleagues, was barely admitted within the bounds of respectable medical circles but was looked upon as a photographer or even as one not far removed from charlatanry, when there was no specialty designated roentgenology or radiology and its entire future was obscure and in doubt. Under such circumstances, with the whole field of medicine open before him, George Holmes had the vision to see tremendous possibilities for the x-ray in medicine and the courage to stake his career on such a faith.

My aim in this address is not to recount the history of the development of radiology in America during its first fifty years. Your own Percy Brown, beloved by radiologists everywhere, Otto Glasser, and many others, have made us familiar with the story of the discovery of the x-ray, the life of its founder, and the contributions of the martyrs who gave their very lives to the development of radiology. It is a drama of work, disappointment, achievement, and tragic personal suffering and early death which now constitutes a magnificent heritage to be claimed by radiologists of the present and future. The full story should be in the intimate posses-

<sup>1</sup> The George W. Holmes Lecture, delivered before the New England Roentgen Ray Society, May 17, 1946

he was poorly educated. On the contrary, he was possessed of a knowledge and culture far beyond most men who boast their college degrees, partly because his innate power of intellect was extraordinary but mostly through sheer hard work and application.

And now I must mention one other pioneer in American radiology without whose contributions to its progress the story would be incomplete. Preston M. Hickey was born in Michigan, when his father was a missionary to the Indians. He had his A.B. degree from the University of Michigan in 1888 and his medical degree from the Medical College of Detroit in 1892. His entire medical career was spent in practice in Detroit and as Professor of Radiology in the University of Michigan at Ann Arbor. When the x-ray was discovered, he was already established in the practice of otolaryngology. So far as I know, he was the only radiologist who was a skilled bronchoscopist. He made his outstanding contributions to American radiology in three fields. Radiological organization was placed on a high plane in the early years of this century by the organization of the American Roentgen Ray Society, and Hickey, Leonard, and Caldwell were the men who established its high medical and ethical standards. The second field to which he gave leadership, beginning with the earliest years, was that of radiological journalism. He personally contributed at least 125 papers to medical literature during his career, but his greatest service in this field was performed in developing a radiological journal. He was the founder and editor of the *American Quarterly of Roentgenology*, which afterwards became the *American Journal of Roentgenology* and finally the *American Journal of Roentgenology and Radium Therapy*. He was editor of the journal until 1916, when James T. Case succeeded him. Perhaps his most important contributions to radiology, however, were made through his work as a teacher at the University of Michigan, from 1922 until his death at the age of sixty-five in 1930.

Here I have named four men who were the fathers of American radiology as we practice it today. Francis Williams has a place somewhat apart. He was essentially a clinician who used the x-ray in his practice. This does not detract from the value of his early and unique contributions to radiological diagnosis, but I am trying to adhere to my subject, which deals with the development of radiology as a specialty. Leonard, who died in 1913, Dodd in 1916, Caldwell in 1917, and Hickey in 1930, were the outstanding leaders of the early days, and it was their individual or combined influence which largely laid the foundations for the present structure. If I were attempting a history of the early days, there are, of course, a large number of important contributors to the progress of radiology who could not be left out. George Pfahler, whose story will some day be told when his work is finished, will have an important place even in the earliest years, especially in the pioneer work in radiation therapy. Frederick Baetjer will be remembered for his early contributions to the radiological diagnosis of diseases of bone, Lewis Gregory Cole will be recognized as the one who placed the x-ray diagnosis of duodenal ulcer on a sound and positive basis, Russell Carman will have a place as an important contributor to radiology of the gastro-intestinal tract, and Henry Pancoast for his work on silicosis. When history is written, many others will doubtless find their proper place in its annals, but I turn again to speak of the four whom I have named—Dodd, Leonard, Caldwell, and Hickey. I have mentioned briefly their differences in origin and training, but let me recall those characteristics which to a greater or lesser degree they held in common. I have already spoken of the extraordinary foresight which gave them the confidence to commit themselves to a career in radiology when to the ordinary doctor, and even to those who were the recognized medical leaders of the day, it held no promise whatever. I speak of this again because, if we are to have continued advance into new fields, there must always

At the same time that Williams was working with the fluoroscope in Boston, Charles Lester Leonard was working in Philadelphia with a small Ruhmkorff induction coil and a Sayen-Queen x-ray tube without protection around it of any kind and was producing roentgenograms of the urinary tract which established the roentgen method for all time in the diagnosis of urinary calculus. Leonard was one of the first of American radiologists to envision the possibility of radiology as a specialty in medicine. His influence was paramount in the organization of the American Roentgen Ray Society on a sound scientific basis. He succumbed to his x-ray injuries at the age of fifty-one, having worked almost to the last hour of his life in perfecting a report on the status of roentgen examination of the gastro-intestinal tract which was read after his death at the International Congress of Medicine in 1913, in London, by Henry Pancoast, who had succeeded Leonard at the University of Pennsylvania in 1903.

Outstanding among the radiologists of that early pioneer day was Eugene Caldwell, of New York. When the x-ray was discovered, Caldwell was an electrical engineer with no medical training. He was only twenty-five years of age but had already been engaged on important research work on submarine telephony. It was evidence of his genius that at such an early age, with no knowledge of medicine, he became interested in the x-ray very soon after its discovery and as early as 1897 had rented rooms from a surgical instrument manufacturer and had established what was probably the first x-ray office in New York City, making x-ray examinations of patients sent to him by doctors. His struggle to establish himself in the new specialty, to study medicine, and finally to obtain a medical degree in 1905, his various inventions of apparatus, his pioneer work in examination of the nasal accessory sinuses and the kidneys, his work as an organizer of the American Roentgen Ray Society along with Leonard and Hickey, and finally his x-ray injuries, suffering,

and death at the age of forty-eight years, all are familiar to those who have listened to or have read the Caldwell Lectures which are delivered annually at the meetings of the American Roentgen Ray Society.

I have sought to find some common characteristics in the early pioneers in radiology, but one is at first impressed more by their differences than by any qualities that they had in common. Consider the four whom I have named. Williams and Leonard were both born in Massachusetts and spent their lives in centers of American culture, one in Boston and the other in Philadelphia. Williams graduated from the Massachusetts Institute of Technology, had his medical degree from Harvard, and spent two years in European universities, after which he practised medicine for over fifty years in Boston. Leonard had his bachelor degrees from the University of Pennsylvania and from Harvard, and his M D and later M A degree from the University of Pennsylvania. Both Williams and Leonard were well educated and secure in the society of their day. Contrast with them the lives of Dodd and Caldwell. Dodd was born in London and came to Boston as an immigrant at the age of fifteen. He made his living at first as assistant in the chemical laboratory at Harvard and later as assistant apothecary and then apothecary at Massachusetts General Hospital. He had little conventional education. He began his medical course at Harvard in 1900 and finally obtained a medical degree from the University of Vermont in 1908. Caldwell was born in Missouri and grew up in the state of Kansas, where he graduated before he was twenty from the Engineering Department of the University of Kansas. He was an electrical engineer when he established his office to make x-ray examinations for physicians, and it was not until 1905 that he obtained a medical degree from the University and Bellevue Hospital Medical College. It would be a mistake, however, to conclude that because Caldwell's education was irregular and unconventional that

within the tube and Herbert Jackson devised a curved cathode to focus the electronic stream on a small area on the target. During the early years of this century there were gradual but important improvements in the construction of tubes, they were made larger and more rugged, and the target was increased in size and thickness and backed by heat-conducting metal and furnished with means of regulating the vacuum. The first great improvement in x-ray apparatus took place in 1908, when Clyde Snook, of Philadelphia, devised the so-called "interrupterless" apparatus. Instead of the induction coil, it used the closed coil transformer and utilized the alternating current by means of a rectifying device of revolving disk or arms. Only those who can remember the annoyances, difficulties, and limitations attendant upon the use of the induction coil with its electrolytic or mercury interrupter can appreciate the revolutionary advance which was made when they were replaced by the high-tension transformer and a device for mechanical rectification of the alternating current. Those of us who lived in communities where only direct current was available were compelled to have our machines equipped with rotary converters, with consequent loss of 50 to 60 per cent in efficiency, but even with this limitation the new machines were a tremendous advance over the coil and interrupter. The new machines were coming into common use in 1910 to 1912 and with their greater output of electrical energy the limitations of the x-ray tubes then available were becoming more and more apparent. Tubes had been improved by the use of tungsten instead of platinum targets, an advance made possible by the work of Wm. D. Coolidge, who had devised a method of rendering tungsten ductile and of compressing it into a solid block, whereas it was before available only in powdered form. This was one of Coolidge's greatest contributions, since it made possible the use of tungsten filaments in electric bulbs and replaced the platinum targets in x-ray tubes with targets of tungsten.

Coolidge's great invention, the Coolidge

tube, which made possible the new, modern era of radiology, was brought to practical perfection in 1912. Those whose entire radiological experience is confined to the period since 1912 will never be able fully to appreciate the difficulties of the days of the old "gas" tube. Fickle and undependable as a source of x-rays, it was replaced by an instrument of precision which, with reasonable attention to details, could be depended upon to duplicate results. Coolidge made another important contribution to radiology by development of the first wholly dependable and practical portable apparatus for military use. For this apparatus he invented a new type of tube called the "radiator" tube.

We come down now to the times that most of you can remember. If you were not practicing radiology when Hollis Potter devised the Bucky-Potter diaphragm, you undoubtedly know by experience its invaluable place in radiological technique. You have seen the advance made when tomography could be applied simply and easily in every roentgen department, and you have witnessed the perfection of cholecystography and myelography to their present high state of excellence. You do not remember the animated and at times acrimonious arguments that were carried on in our meetings and in our journals concerning the relative value of fluoroscopy and roentgenography in examinations of the gastro-intestinal tract, but you have witnessed the combination of both in the spot-film method of examination. Within very recent years you have seen rotating target tubes come into general use. During the past five years fluorophotographic methods have been perfected to such a degree that they are highly efficient and indeed invaluable for mass survey of the chest. Most recently of all you have witnessed the perfection of a photoelectric timer which operates on fluorophotographic apparatus with uncanny precision.

How far we have traveled in the technical aspects of radiology since those early days of coil, interrupter, and fragile gas tubes! But we are far from satisfied

be confidence in the possibility of progress and there must be constant encouragement of that spirit of scientific imagination whenever we recognize it in ourselves or in students or assistants. This very force with which we work every day, the x-ray, should be calling us to take the forward look. Has it not revolutionized our knowledge of the world in which we live? Dr A. H. Compton, in a recent article, recalls how Professor Michelson, when dedicating the Ryerson Physical Laboratory at the University of Chicago in 1893, had stated that the fundamental principles of physics were then well established and that it remained now only to make more precise measurements of the known physical constants. As Dr Compton remarks, we were living up to that time in "a determined world, precisely predictable according to laws that were clearly known." It was a world all neatly arranged in known patterns made up of a certain number of elements, each of which in turn was composed of a known number of atoms. Roentgen's discovery fell into that neatly arranged world with an effect upon the physical theories of the day comparable to the effect of the explosion of the atomic bomb upon the social life of our own day. Soon we were living in a world, not of inert elements, but of electrons, protons, and neutrons. The world which had been fixed and determined was a world in flux, seething with constant change in its ultimate structure. Should not we who are working every day with the force which is responsible for our knowledge of the structure of the physical universe in which we live take from these profound changes which it has brought about a lesson in the proper attitude of mind that should be maintained toward the possibility of progress? Should it not be an attitude of eager anticipation, in Wordsworth's fine phrase, of "something evermore about to be?"

From this essential quality of vision, faith in the possibility of progress, or whatever you wish to call it, I turn to another which seems prosaic in contrast but which is necessary to prevent "scientific imagi-

nation" from becoming simply "imagination" or visionary wishful thinking. It is a power which all of the pioneers, without exception, possessed, and which Dr Holmes and every one of his students whom I have had the good fortune to observe have possessed in high degree—the power of accurate observation. It has been a characteristic of all great clinicians and I need not dwell upon its prime importance in the radiologist. We can never be too exacting in training ourselves to observe every detail present upon screen or film. Hickey used to say "Look at the four corners of the film." Recently I have seen a student who was being quizzed on a film miss the diagnosis because he failed to observe this precaution. The diagnosis was plainly written in white ink on the corner of the film. A good rule to observe when the diagnosis seems quite obvious is to cultivate the habit of re-examining the film for everything else that may be seen which could denote abnormality, and, conversely, when we are priding ourselves upon a diagnosis based upon keen observation and accurate interpretation of obscure deviations from the normal, to look again and again to see if there is not something else glaringly obvious on the film. Of course, if the accurate observer is to secure his best results, he must have films of the best quality. The pioneer workers were all good technicians. To see the really beautiful films made by Leonard or Caldwell with the crude apparatus available to them must often make us ashamed of the relatively poor results that are today turned out in the average roentgen department with the most modern apparatus. The fact that an important diagnosis often depends upon good films must make us exceedingly exacting in our demands for excellent technic at all times.

This is the place to speak of the inventions and improvements in apparatus that have made possible our present marvelous technical results. X-ray tubes were at first small and fragile. The first important advances were made when Campbell-Swinton suggested placing a metal target

lege today represents the combined strength of American radiology and deserves the whole-hearted support of every radiologist. It is quite unimportant that the name "College" is not quite appropriate for such an organization. The American Roentgen Ray Society occupies the place which could be appropriately designated "academy" or "college," and the Radiological Society of North America fills the need of an organization home for all radiologists who are interested in improving themselves by contact with their fellows. It seems to me clear that all three organizations are highly desirable and are necessary for the health and continued progress of radiology in America.

The status of radiology was greatly strengthened by the formation of the Section on Radiology of the American Medical Association in 1921. This was the first official recognition of radiology as a separate specialty in medicine. The existence and operation of the section at the annual meetings and publication of its papers in the *Journal of the American Medical Association* serve to strengthen the position of radiology in American medicine and of radiologists in relation to all other practitioners. The section was not established without much work over a period of several years by many radiologists. Its position in the American Medical Association should be jealously guarded and maintained.

To complete the picture of national organization, we must not fail to speak of the organization of the American Board of Radiology in 1934. The Board was sponsored by all of the national radiological societies and each society is continuously represented by three members on the Board. No body is more nearly representative of all American radiologists than is the Board since, in addition to the four organizations I have mentioned, the American Radium Society also is represented. The standing of the Board is now assured, and there is no doubt that its diploma will be of increasing value as time passes.

Radiology in America begins the second

half of its first century well organized both for scientific advance and for meeting its socio-economic obligations. There are no important disagreements in its ranks such as were present in earlier years and it finds itself well integrated into general medical organization in the United States.

In all of these activities, from 1911 until his recent retirement, George Holmes had an important part. Typical of his interest and leadership in radiological organization was his part in the formation and operation of the American Board of Radiology. He was a member of the original committee set up by the radiological organizations to make plans and recommendations for establishing a board. He was a member of the Board when it was formed and has remained a member ever since, having served as its president for several years. Among the honors that came to him was the presidency of the American Roentgen Ray Society. All of these offices he has filled with conscientious zeal, but I am sure they always had a secondary place in his mind. His heart and soul were in his professional work. Radiology to him has always been an integral part of medical practice. This has been true of all the great leaders in radiology. They were never content to be less than medical consultants. Hickey and Leonard were clinicians before they became radiologists, and they remained clinicians when they became specialists in radiology. You remember how Dodd and Caldwell never rested until they were qualified to practice medicine. Among all of the leaders since that time no one has more consistently adhered to this method of practice than Holmes. Radiology is essentially a "clinical" and not a "laboratory" specialty. For that reason it is well to speak of the roentgen "department" and not of the roentgen "laboratory." I hold it to be a cardinal requirement that the radiologist shall have personal contact with his patients. It is only so that radiology can be practised on its highest plane. It is my hope that very early in the second fifty years of radiology the practice of relying

Now, at the beginning of the second half century, we are eager to see improvement along many lines. We want further improvement in x-ray tubes so that they will be more durable and dependable, we think the time is ripe for considerable improvement in both x-ray films and intensifying screens, we want manufacturers to devise new darkroom equipment based upon experience gained in industrial plants, we are eager for improvements in fluoroscopic screens and especially for early exploration of the possibility of electronic amplification of the image. The recent development of cardio-angiography by Robb and others would be greatly facilitated if the fluorophotographic method could be applied to it, and we want to see intensified investigation of the possibility of utilizing the fluorophotographic method in gastro-intestinal studies and in other parts of the body. While we are looking back at the foundations laid by the pioneers of the last fifty years, let us not forget that among us now must be the pioneers for the advances to be made in the next fifty years.

All of these matters that I have just been discussing are of fundamental importance in the practice of radiology, technological procedures are basic and cannot be neglected. Nevertheless, it was characteristic of the pioneers and of the leaders in each succeeding generation that they did not confine their attention to mechanical and technical details. After all, such details are only means to more important ends. I have already mentioned the attention given by Hickey, Caldwell, and Leonard to organizing the American Roentgen Ray Society, which was the pioneer American radiological society. It has been in continuous existence and active operation since its organization in 1900. One of its greatest services to radiology has been its publication of *The American Journal of Roentgenology and Radium Therapy*. The Society has maintained high standards for membership and its annual meetings and its journal have continuously contributed to the progress of both the science and art of radiology.

The Radiological Society of North America is a different type of association but a necessary and valuable part of radiological organization in America. It originated in the Western Roentgen Society in 1916 and grew out of the necessity for an organization home for the large number of younger radiologists and for many who were doing the limited practice of small communities. After some vicissitudes, it adopted its present name in 1928. The Society has a large membership, including most of those who are members of the American Roentgen Ray Society. Its annual meetings are largely attended and are valuable both from an educational and inspirational standpoint for the great body of American radiologists. The Radiological Society also publishes an excellent journal, *RADIOLOGY*.

The American College of Radiology was organized in 1923, but it was not until about 1937 that it found a useful place in the total organizational picture of American radiology. It had become apparent before that time that neither the American Roentgen Ray Society nor the Radiological Society of North America could effectively represent the radiologists of America in all of those increasingly important fields which involve public relations, legislation, hospital relations, and education. In that year, 1937, the College secured a full-time executive secretary, established permanent offices in Chicago, and enlarged its membership to include the great majority of American radiologists who hold the diploma of the American Board of Radiology. The College is recognized by both the American Roentgen Ray Society and the Radiological Society of North America, each of which has a member on its Board of Chancellors. It is now recognized generally as truly representative of the radiologists of America and its voice carries the weight of organized radiology when it speaks before the American Medical Association, the American Hospital Association, or any other organization, or to national or local legislative bodies or to the general public through press or radio. The Col-



It is impossible to estimate the beneficial influence of these two teachers upon the development of radiology in the United States through their own personal work and publications and that of their students. Of the two, Holmes' total influence has been the greater because he has trained a much larger number of students than Hickey, who began his real teaching career late in life.

We now enter upon the second fifty years of radiology with a heritage of achievement hardly equalled in any field in any like period of human history. We look back with pride and gratitude to those whose leadership has brought us to this day when radiology is firmly established as a great medical specialty. We look forward confidently but humbly to the future. We feel very keenly the truth of the first aphorism of the founder of medicine "Life is short, the art is long, the occasion fleeting, experience fallacious, and judgment difficult." We go forward, however, with an optimistic confidence in future progress born of the vision be-

queathed to us by the leaders of the first half century of our existence.

In closing, I wish to express to the officers and members of this Society my appreciation for the invitation to deliver this annual address. I am especially gratified that it has been my privilege to give it in the presence of the one in whose honor the lectureship is founded. George Holmes and I are contemporaries in the practice of radiology. At almost the exact time that he chose to enter the field of radiology, I became a radiologist "by order of the Surgeon General of the Army." When I think of the many years of our association, which has become an abiding friendship, I feel like quoting a little verse written by Sir William Watson but quoted by Gilbert Chesterton in reference to his friend Hilaire Belloc.

"Not without honor my years ran,  
Nor yet without a boast shall end,  
For I was Shakespeare's countryman,  
And were not *you* my friend?"

1835 Eye St., N.W.  
Washington 6, D.C.

upon film reading alone will largely disappear and that everywhere radiologists will follow the best traditions of our specialty which have been established by the leaders during the first fifty years. If they do so, they will find themselves occupying an increasingly important place as honored and valuable medical consultants. That there are any insuperable economic difficulties to the accomplishment of this end, I do not believe. If they do not do so, they can readily be replaced by a combination of the x-ray technician and the specialists in other branches who interpret their own films.

The necessity for closely integrating radiology with clinical medicine is greater now than ever before because of many recent advances in various fields. The advent of chemotherapy and penicillin has brought about important modifications in roentgen criteria which the radiologist can interpret correctly only if he is in touch with the clinical aspects of the case in question. The advances in surgery of the chest are such that it is only by frequent consultation with the chest surgeon and close co-operation with him that the radiologist can render the great service that is expected of him today. The same holds true in the gastro-intestinal tract, the brain, and other fields.

This co-operation that can come about only by frequent consultation between the radiologist and other clinicians is, if possible, more important in the field of therapy than in that of diagnosis. It was in this field that Holmes made one of his outstanding pioneer contributions. The thyroid clinic at the Massachusetts General Hospital, of which he was the main moving spirit, acting as *liaison* between surgeon and internist, gave the inspiration and example for tumor clinics. It is now recognized that the best method of dealing with the problem of diagnosing and treating cancer is through the well organized tumor clinic, in which the surgeon, the radiologist, the internist, and the clinical pathologist all have equal voice and in which no one of them is dominant. In such clinics the

radiologist occupies a strategic position because of the contribution that he must make both to the diagnosis and treatment of cancer.

Even in such a fragmentary account of the place of George Holmes in the development of American radiology as I have been able to give in this address, I cannot omit reference to what has constituted probably the most important aspect of his life's work, the contributions which he has made as a teacher. Among the early pioneers of radiology, Holmes' closest counterpart was Hickey, who was also a great teacher. In personality the two were much alike. I have known them both as quiet, modest, kindly men, who, throughout their lives, took a keen interest in training and developing younger men. Both of them always exhibited a kindly sympathy and understanding in their relations with students and assistants, but both were exacting in their requirements. Their students had to be well founded in pathology, especially in gross pathology, and in their knowledge of internal medicine. Before final conclusions could be drawn in any case, the roentgen findings had to be correlated with the history and clinical aspects of the case. Their students also received thorough training in the technical phases of radiology and were constantly drilled to develop keen powers of observation. The thoroughness and fundamental nature of the training received by the students of both Holmes and Hickey remind one, by contrast, of the sententious reply which Thoreau made to Emerson when the latter said to him that he understood that Harvard was now teaching all branches of knowledge. "Yes," said Thoreau, "all of the branches, but none of the roots." Like all great teachers, Hickey and Holmes inspired their students by their personal example. Both of them occupied places of dignity and influence on their respective faculties and hospital staffs. They demonstrated daily in consultations with individual physicians and in clinical conferences the important place of radiology in the whole medical field.

and roentgenologist, naturally leads to better treatment of the patient and increased knowledge of the disease. The intelligence and the ability to obtain co-operation which enabled Dr. Holmes to establish the first tumor clinic are an unquestionable contribution to the field of cancer research.

Now, after training 45 residents in this specialty and having had 50 graduate assistants under his tutelage for six months or more, Dr. Holmes has returned to

Maine, his native state, but he is still interested in our progress. He returned to hear Dr. Arthur C. Christie, an old friend and roentgenologic associate, deliver the second George W. Holmes Annual Lecture on May 17, 1946. The opportunity of reading both lectures, which appear in this issue of *RADIOLOGY* (pages 602 and 608), will be of inestimable value to both the embryo and the well-developed radiologist.

HUGH F. HARE, M.D.

## Employment of Persons with Defective Vision as Darkroom Technicians

In September 1944, the Philadelphia Naval Hospital began the use of blinded veterans as X-ray darkroom technicians.<sup>1</sup> This was undertaken both to alleviate the man-power shortage existing at the time and as part of the rehabilitation program for these veterans. The initial test met with such success that the practice has not only been continued in the Philadelphia Hospital but has been incorporated as part of the rehabilitation program for the blind at Army Hospitals at Avon, Conn., and Valley Forge, Penna.

The selection of personnel for this task must be carefully undertaken, as the blind are subject to all the faults of the sighted, with the additional handicap of diminished vision. The work requires intelligence and a sense of responsibility along with meticulous attention to details in order to minimize mistakes. There is no doubt that personnel with light perception learn faster and make fewer initial errors than the totally blind. Once the routine is memorized, however, work progresses smoothly. As is well known, the average technician usually shuns this type of work simply because it is confining and must be done in partial darkness. The man or woman with diminished sight does not mind this restriction and is stimulated by the responsibility placed upon him.

Few modifications in equipment are necessary. After the temperature of the inflowing water has been controlled, a strict time schedule in developing and fixing is followed. Braille aneroid type thermometers are manufactured by the Perkins Institute for the Blind, of Watertown, Mass. These may be partially enclosed, for protection, in a copper case and submerged in the developing solution. A source of error of one to two degrees between the air and water temperature exists, but this variation may be recognized and adjusted with experience. With accurate thermostatic control this error is minimized. The usual interval timer is adapted by fixing lead shot to the face with adhesive. A metal pointer may be fastened to the setscrew if the face is covered by glass.

In addition to the World War II veterans with diminished vision, there are in many communities others similarly handicapped, who are deserving of the opportunity of gainful employment. These people as a group want no favors, but are extremely grateful for the opportunity to prove their ability at certain tasks. Darkroom work fits in this category. This job can be ably handled by the blinded, particularly in hospitals or offices with sufficient work-load to utilize full-time darkroom help, while other employees assume the more demanding technical duties elsewhere.

ELLWOOD W. GODFREY, M.D.

<sup>1</sup> GERRY, ROGER A., AND KOCH, FAITH C. X-ray Darkroom Training as an Adjunct to the Rehabilitation of the Blind. *U S Nav M Bull* 46: 1382-1387, September 1946.

# EDITORIAL

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## The George W Holmes Annual Lecture

On May 16, 1945, Dr George Winslow Holmes delivered the annual oration of the New England Roentgen Ray Society. Immediately following his lecture, it was proposed, and unanimously approved by the Society, that this lecture be designated the first George W Holmes Annual Lecture and that each year some outstanding scientist, regardless of specialty, be invited to deliver, at the closing session of the Society, the annual Holmes Lecture.

In creation of this lecture the respect and love of all members of the Society for Dr Holmes played equal parts. Many members of the group received their training in radiology under his tutelage at the Massachusetts General Hospital, while others have been trained by his intellectual sons and grandsons. Quite apart from this, the respect in which he is held by all members of the Society has increased during the years not only for his ability as a radiologist, but for his zeal and quality in the practice of medicine. He has, furthermore, a quality difficult to describe in words but invariably associated with him, the ability not alone to think clearly but to give expression to his thoughts and ideas with clarity and simplicity for those of us who are less gifted.

Dr Holmes received his medical degree from Tufts Medical School in 1906, following which he served his internship in the Long Island Hospital and the Boston City Hospital. His first formal touch with radiology came when he was appointed assistant skiagrapher at the Massachusetts General Hospital in December 1910. There he received training under Dr Walter Dodd. In December 1911 his title was changed to assistant roentgenologist, and in this capacity he continued to be asso-

ciated with Dr Dodd until the latter's death in 1917. Dr Holmes then became roentgenologist at Massachusetts General Hospital, a post which he held until his retirement in 1941. On Sept 11, 1942, he was recalled to active duty as chief, and served for the duration of the war, until June 1945. The positions held by Dr Holmes in the Harvard Medical School closely paralleled those at the Hospital. He served as assistant in roentgenology from 1913 to 1917, instructor in roentgenology from 1917 to 1923, assistant professor of roentgenology from 1923 to 1931, and clinical professor of roentgenology from 1931 to 1941. On his retirement from the Hospital in 1941 he was named Professor Emeritus.

There are few of us who have entered the medical field who have not studied Dr Holmes' textbook, *Roentgen Interpretation*, first published in 1919 and now going into its seventh edition. This book, which has stood the test of time both for students and roentgenologists, is clear, precise, and complete. To realize how well it was originally done, it is necessary only to review the most recent edition and see how many of the original plates and diagnostic methods are unchanged.

As may be judged by reading the annual oration delivered by Dr Holmes, his interests were divided between diagnosis and therapy. The study of malignant growths and their proper treatment was of paramount interest to him. It was his idea to form the tumor clinic of the Massachusetts General Hospital, which holds high rank today and has been a model for many others throughout the country. The tumor clinic, offering as it does the combined opinions of the pathologist, surgeon,

the x-ray equipment business in the capacity of a salesman, in 1905. From that time until his death he was continuously associated with the industry. His career thus paralleled the development of radiology from its early days to its present position as one of the great medical specialties.

## Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

**PRINCIPLES IN ROENTGEN STUDY OF THE CHEST** By WILLIAM SNOW, M.D., Director of Radiology, Bronx Hospital, Roentgenologist-in-charge, Harlem Hospital, New York City. A volume of 414 pages, with 508 illustrations. Published by Charles C Thomas, Springfield, Ill., 1946. Price \$10.00.

**A HANDBOOK OF RADIOGRAPHY** By JOHN A. ROSS, M.A. (Camb.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.M.R.E. (L'pool), Visiting Radiologist, Alder Hey Children's Hospital, Liverpool, Hon. Radiologist, Warrington Infirmary, Warrington, Radiologist, General Hospital, Warrington, Hon. Radiologist, The St. Helens Hospital, St. Helens, Lancs., Clinical Assistant, X-Ray Department, Royal United Hospital, Liverpool, Assistant Lecturer in Radiology, University of Liverpool. A volume of 165 pages with 92 illustrations. Published by H. K. Lewis & Co., Ltd., London, 2nd ed., 1946. Price 10/6d net.

## Book Reviews

**THE CHEST. A HANDBOOK OF ROENTGEN DIAGNOSIS** By LEO G. RIGLER, M.D., Professor and Chief, Department of Radiology, University of Minnesota. A volume of 352 pages, with 338 illustrations. Published by The Year Book Publishers, Chicago, 1946. Price \$6.50.

The "atlas plan" of presentation is particularly well adapted to roentgenologic treatises and the Year Book Publishers have done well to employ it in their excellent series of Handbooks on Roentgen Diagnosis. The volume on *The Chest*, the fifth in the series, follows the plan of its predecessors—a brief description of the salient points of roentgen examination and diagnosis for the conditions under consideration, followed and illuminated by a series of plates with accompanying descriptions. The illustrations, for the most part from the author's own files, are excellent and appear to have lost little in reproduction.

Methods of roentgenographic and fluoroscopic examination are described in a preliminary chapter, and photofluorograms are reproduced for comparison with standard films. A brief discussion of the

indications for body-section roentgenography is also included, but the author has omitted details of the technique as too elaborate for a handbook of this type.

The second of the three main divisions of the book is devoted to the normal chest, the anatomic variations which may be expected, the bronchographic findings, and the physiology of the respiratory tract. An interesting feature is the diagrammatic representation of the various anatomic structures superimposed upon postero-anterior and lateral films of the normal thorax.

The bulk of the book, as would be expected, is devoted to the diseases of the chest, taking up in order the lungs and bronchi, mediastinum, and pleura.

Dr. Rigler's wide experience as a teacher is reflected in the many helpful suggestions which he has included, as well as in his clear and succinct presentation of facts. The book will have a great usefulness in the hands of the student and practitioner as well as in the roentgenologic laboratory.

**THE 1946 YEAR BOOK OF RADIOLOGY**, July, 1945–June, 1946. Diagnosis, edited by CHARLES A. WATERS, M.D., Assistant Professor of Roentgenology, Johns Hopkins University School of Medicine, Associate Editor, WHITMER B. FIROR, M.D., Instructor in Roentgenology, Johns Hopkins University School of Medicine. Therapeutics, edited by IRA I. KAPLAN, M.D., Director, Radiation Therapy Department, Bellevue Hospital, New York City, Clinical Professor of Surgery, New York University Medical College, Associate Editor, SIDNEY RUBENFELD, M.D., Visiting Radiation Therapist, Bellevue Hospital. A volume of 463 pages, with 408 illustrations. Published by The Year Book Publishers, Inc., Chicago, Ill., Price \$5.50.

The *Year Book of Radiology* has become so much a part of the radiological literature of America that a review of the latest volume seems almost superfluous. The present issue, as we are reminded in the introduction, is the first "to be compiled, edited and published during the Atomic Age," but the editors have wisely resisted any temptation to stray too far afield from the realm of medical radiology.

The volume covers chiefly the period between July 1945 and June 1946, but happily there have been included some earlier papers from the foreign literature not previously available. It is well to have some of the gaps created by the conditions of world conflict thus filled. While the material is presented largely in the form of abstracts, these are so classified and arranged that the effect is that of a continuous review presented under appropriate headings. The abstracts themselves are comprehensive, though concise, and are well illustrated by excellent reproductions of many of the original cuts. It is gratifying to see that each picture carries in its legend adequate acknowledgment of the source. Brief but pointed editorial comments throughout the work enhance its value.

## ANNOUNCEMENTS AND BOOK REVIEWS

### MINNESOTA RADIOLOGICAL SOCIETY

At the meeting of the Minnesota Radiological Society in Rochester, on Oct 26, the following program was presented

Radioactive Iodine in the Treatment of Exophthalmic Goitre *S F Haines*  
Unusual Case of Giant Cell Tumor of Bone Treated with X-Ray *J J Wells*  
X-Ray Treatment of Malignancy of the Testis

*E T Luddy*  
Review of Different Methods of Radium Therapy for Carcinoma of the Cervix *L M Vaughan*  
Essential Principles of Radium Therapy for Carcinoma of the Cervix *H H Bowing*  
Role of Alpha and Beta Particles in Radium Therapy *R E Fricke*  
Loss of Radon from Radon Ointment

*M M D Williams*  
Amoebiasis in Naval Personnel *John D Camp*  
A Case of Diffuse Lymphomatous Involvement of the Colon *Harry M Weber*  
The Clinical Syndrome Associated with Pulmonary Arteriovenous Fistula Report of a Case

*H B Burchell*  
Motion Picture A Case of Pulmonary Arteriovenous Fistula *H B Burchell and O T Clagett*  
The Diagnosis of Carcinoma of the Stomach by Chest Radiography *B R Kirklin*  
Thymic Tumor Associated with Myasthenia Gravis

*C Allen Good*  
Scleroderma of the Viscera *David G Pugh*  
Lesions of the Small Bones of the Feet Neurotrophic or Infectious? *John R Hodgson*

The dinner speaker, introduced by Dr Charles Sutherland, was E J Baldes, who took as his subject "Europe Today"

### TEXAS RADIOLOGICAL SOCIETY

The next meeting of the Texas Radiological Society will be held at the Rice Hotel, Houston, Jan 25, 1947

### INDIAN JOURNAL OF RADIOLOGY

At the First Indian Congress of Radiology, held in Madras in February of this year, it was decided to undertake the publication of an *Indian Journal of Radiology*. The new journal is to appear quarterly under the auspices of the Indian Radiological Association (155-157 Poonamallee High Road, Kulpauk, Madras). The editors are Dr P Rama Rau and Dr K M Rai, both of Madras

### PROFESSOR H HOLTHUSEN

The following excerpts are from a letter received from Professor Holthusen of Hamburg, Germany,

by Dr E R Bowie of New Orleans. We are indebted to Dr Bowie for permission to reproduce them here

"Taking into account the extraordinary circumstances of the time being, my family and myself are well off. Certainly we can never forget that our eldest son did not return from service but fell towards the end of the war near the German frontier in Luxembourg. My two younger sons, who also served in the army, returned safely without being seriously injured. They are now students at the University of Hamburg. We had the unlikely chance to save our home during the whole time of air-raids and still to live in it, although of course we have given away part of it to fugitives and out-bombed persons, so that we ourselves are now restricted to the upper floor. I lost my private Roentgen Laboratory July 1943 by fire but had the chance to save my "Strahlennstitut" at St Georges Hospital. So I am able to continue my work as the Radiologist of that hospital. Under present conditions it would have been impossible to rebuild the plant if it had been destroyed.

"Certainly we have to face many difficulties arising from the very severe housing question and concerning the feeding question, a problem especially complicated in the big towns. Nevertheless, we are looking forward with good hope and we were widely encouraged by the speech delivered by your Prime-Minister Byrnes at Stuttgart last week. [Dr Holthusen's letter is dated Sept 9, 1946.] The amount of material and spiritual destruction in our country is enormous. The cutting off of all communications with our friends abroad in consequence of the isolation provoked by the narrow minded and criminal policy of the Nazis belongs to it. Only very gradually we shall be able to repair these damages. While I hope that in times to come the relations with our colleagues abroad and the co-operation with them will be restored I feel that it is still much too early to show any activity from our side. I consider it a great privilege for me that you have again extended your hand towards me. Your letter has indeed produced in my heart very warm feelings of thankfulness and the memory of so many lucky hours spent in your country, especially during my first journey to the United States in 1929.

### In Memoriam

CARL F DICK, M D

Dr Carl F Dick, a pioneer in the field of X ray equipment and founder of the Dick X Ray Company, died on Oct 20. Dr Dick was born on July 19, 1878, at Cannelton, Ind. He was graduated in medicine from Vanderbilt University, and after a short period of practice in Evansville, Ind, entered

# RADIOLOGICAL SOCIETIES OF NORTH AMERICA

*Editor's Note*—Will secretaries of societies please co-operate by sending information to the editor

## UNITED STATES

*Radiological Society of North America*—Secretary, D S Childs, M D, 607 Medical Arts Bldg, Syracuse 2, N Y  
*American Roentgen Ray Society*—Secretary, Harold Dabney Kerr, M D, Iowa City, Iowa.  
*American College of Radiology*—Secretary, Mac F Cahal, 20 N Wacker Dr, Chicago 6, Ill  
*Section on Radiology, A M A*—Secretary, U V Portmann, M D, Cleveland Clinic, Cleveland 6, Ohio

## ALABAMA

*Alabama Radiological Society*—Secy-Treasurer, John Day Peake, M D, Mobile Infirmary, Mobile

## ARKANSAS

*Arkansas Radiological Society*—Secretary, Fred Hames, M D, Pine Bluff Meets every three months and annually at meeting of State Medical Society

## CALIFORNIA

*California Medical Association, Section on Radiology*—Secretary, D R MacColl, M D, 2007 Wilshire Blvd, Los Angeles 5  
*Los Angeles County Medical Association, Radiological Section*—Secretary, Roy W Johnson, M D, 1407 South Hope St., Los Angeles Meets second Wednesday of each month at County Society Building  
*Pacific Roentgen Society*—Secretary, L Henry Garland, M D, 450 Sutter St, San Francisco 8 Meets annually with California Medical Association  
*San Diego Roentgen Society*—Secretary, R F Niehaus, M D, 1831 Fourth Ave., San Diego, Calif Meets first Wednesday of each month  
*San Francisco Radiological Society*—Secretary, Joseph Levitt, M D, 516 Sutter St, San Francisco 2 Meets monthly on the third Thursday at 7 45 P M, first six months of the year in Lane Hall, Stanford University Hospital, and second six months in Toland Hall, University of California Hospital.

## COLORADO

*Denver Radiological Club*—Secretary, Washington C Huyler, M D, Mercy Hospital, Denver 6 Meets third Friday of each month, Colorado School of Medicine

## CONNECTICUT

*Connecticut State Medical Society, Section on Radiology*—Secretary, Robert M Lowman, M D, Grace-New Haven Hospital Grace Unit, New Haven Meetings bimonthly, second Thursday

## FLORIDA

*Florida Radiological Society*—Secy-Treasurer, Maxey Dell, Jr, M D, 333 West Main St, S, Gainesville

## GEORGIA

*Georgia Radiological Society*—Secretary-Treasurer, James J Clark, M D, 478 Peachtree St, N E, Atlanta 3 Meets in November and at the annual meeting of State Medical Association

## ILLINOIS

*Chicago Roentgen Society*—Secretary, T J Wachowski, M D, 310 Ellis Ave, Wharton Meets at the

Palmer House, second Thursday of October, November, January, February, March, and April

*Illinois Radiological Society*—Secretary-Treasurer, William DeHollander, M D, St Johns' Hospital, Springfield Meetings quarterly by announcement

*Illinois State Medical Society, Section on Radiology*—Secretary, Frank S Hussey, M D, 250 East Superior St, Chicago 11

## INDIANA

*The Indiana Roentgen Society*—Secretary-Treasurer, J A Campbell, M D, Indiana University Hospitals, Indianapolis 7 Annual meeting in May

## IOWA

*The Iowa X-ray Club*—Secretary, Arthur W Erskine, M D, 326 Higley Building, Cedar Rapids Meets during annual session of Iowa State Medical Society

## KENTUCKY

*Kentucky Radiological Society*—Secy-Treasurer, Sydney E Johnson, M D, 101 W Chestnut St, Louisville

## LOUISIANA

*Louisiana Radiological Society*—Secretary-Treasurer, Johnson R Anderson, M D, No Louisiana Sanitarium, Shreveport Meets with State Medical Society  
*Orleans Parish Radiological Society*—Secretary, Joseph V Schlosser, M D, Charity Hospital of Louisiana, New Orleans 13 Meets first Tuesday of each month  
*Shreveport Radiological Club*—Secretary, Oscar O Jones, M D, 2622 Greenwood Road Meets monthly September to May, third Wednesday, 7 30 P M.

## MARYLAND

*Baltimore City Medical Society, Radiological Section*—Secretary, Charles N Davidson, M D, 101 West Read St, Baltimore 1

## MICHIGAN

*Detroit X-ray and Radium Society*—Secretary-Treasurer, E R Witwer, M D, Harper Hospital, Detroit 1 Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms

## MINNESOTA

*Minnesota Radiological Society*—Secretary, A T Stenstrom, M D, Minneapolis General Hospital, Minneapolis 26 Meetings quarterly

## MISSOURI

*Radiological Society of Greater Kansas City*—Secretary, John W Walker, M D, 306 E 12th St, Kansas City, Mo Meetings last Friday of each month

*St Louis Society of Radiologists*—Secretary, Edwin C Ernst, M D, 100 Beaumont Medical Bldg Meets on fourth Wednesday of each month, October to May

## NEBRASKA

*Nebraska Radiological Society*—Secretary-Treasurer, Donald H Breit, M D, University of Nebraska Hospital, Omaha 5 Meetings third Wednesday of each month at 6 P.M in either Omaha or Lincoln

## NEW ENGLAND

*New England Roentgen Ray Society*—Secretary-Treasurer, George Levene M D Massachusetts Memorial

Dr Charles A. Waters and Dr Whitmer B. Frior continue to edit the section on Diagnosis, while Dr Ira I. Kaplan is joined by Dr Sidney Rubinfeld in editing the section on Radiotherapeutics. All are to be congratulated on maintaining the high standard of excellence that has been set by the earlier volumes in the series.

**MONGOLISM AND CREPINISM. A STUDY OF THE CLINICAL MANIFESTATIONS AND THE GENERAL PATHOLOGY OF PITUITARY AND THYROID DEFICIENCY.** By CLEMENS E. BENDA, M.D., Director, Wallace Research Laboratory for the Study of Mental Deficiency, Wrentham, Mass., Instructor in Neuropathology, Harvard Medical School, Assistant in Psychiatry, Massachusetts General Hospital, Lecturer, Postgraduate Seminar, Massachusetts Department of Mental Health. A volume of 310 pages, with 101 illustrations. Published by Grune & Stratton, New York, 1946. Price \$6.50.

The astounding incidence of mongolism in the United States, placing its blight on six thousand newborn infants annually and multiplying its misery through six thousand families, is indicative of the

need of a thorough study of this problem. Dr Benda's timely book is a scholarly milestone on the road to a fuller understanding of the condition.

The clinical picture of the disease is reviewed in detail, and the occurrence in both infants of four pairs of fraternal dizygotic twins is described, added evidence that the maternal state of health has a direct bearing on the offspring, as opposed to an inheritance factor. One chapter is devoted to the roentgenologic aspects of mongolism and cretinism. Roentgen studies of the carpal centers, indicating low thyroid function, and of the hand, showing the pathologic middle phalanx of the little finger, are presented, and the x-ray characteristics of the mongoloid and cretin skull are discussed. Considerable space is devoted to the physiology and clinical interpretation of the maternal state during pregnancy, a field in which the next great advances will probably be made. An important chapter is included on prevention, in relation to maternal age, maternal exhaustion, tendency to abortion, periods of sterility, and actual disease. Careful directions regarding treatment of the child are included, with a discussion of pituitary and thyroid preparations. The book is a library of facts about mongolism, relating them in a comparative way to cretinism.





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Hospitals, Boston, Mass Meets monthly on third Friday at Boston Medical Library

#### NEW HAMPSHIRE

*New Hampshire Roentgen Society*—Secretary, Albert C Johnston, M D, Elliot Community Hospital, Keene

#### NEW JERSEY

*Radiological Society of New Jersey*—Secretary, W H Seward, M D, Orange Memorial Hospital, Orange Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called

#### NEW YORK

*Associated Radiologists of New York, Inc*—Secretary, William J Francis, M D, East Rockaway, L I

*Brooklyn Roentgen Ray Society*—Secretary-Treasurer, Abraham H Levy, M D, 1354 Carroll St, Bklyn 13 Meets fourth Tuesday of every month, October to April

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*Radiological Society of North Carolina*—Secretary-Treasurer, James C Hemphill, M D, Professional Bldg, Charlotte 2 Meets in May and October

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*Ohio Radiological Society*—Secretary, Henry Snow, M D, 1061 Reibold Bldg, Dayton 2 Next meeting at annual meeting of the Ohio State Medical Association

*Central Ohio Radiological Society*—Secretary, Hugh A Baldwin, 347 E State St, Columbus

*Cleveland Radiological Society*—Secretary-Treasurer, Carroll C Dundon, M D, 11311 Shaker Blvd, Cleveland 4 Meetings at 6 30 P M on fourth Monday of each month from October to April, inclusive

*Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists)*—Secretary-Treasurer, Samuel Brown, M D, 707 Race St, Cincinnati 2 Meetings held third Tuesday of each month

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*Philadelphia Roentgen Ray Society*—Secretary, Calvin L Stewart, M D, Jefferson Hospital, Philadelphia 7 Meets first Thursday of each month at 8 00 P M, from October to May in Thomson Hall, 21 S 22d St

*Pittsburgh Roentgen Society*—Secretary-Treasurer, Lester M J Freedman, M D, 415 Highland Bldg, Pittsburgh 6 Meets second Wednesday of each month at 6 30 P M, October to May, inclusive

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*Memphis Roentgen Club*—Meetings second Tuesday of each month at University Center

*Tennessee Radiological Society*—Secretary-Treasurer, J Marsh Frère, M D, 707 Walnut St, Chattanooga Meets annually with State Medical Society in April

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*Dallas-Fort Worth Roentgen Study Club*—Secretary, X R Hyde, M D, Medical Arts Bldg, Fort Worth 2 Meetings on third Monday of each month, in Dallas in the odd months and in Fort Worth in the even months.

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*Milwaukee Roentgen Ray Society*—Secretary-Treasurer, C A H Fortier, M D, 231 W Wisconsin Ave, Milwaukee 3 Meets monthly on second Monday at the University Club

*Radiological Section of the Wisconsin State Medical Society*—Secretary, S R Beatty, M D, 185 Hazel St Oshkosh Two-day meeting in May and one day at annual meeting of State Medical Society in September

*University of Wisconsin Radiological Conference*—Meets first and third Thursdays 4 to 5 P M, September to May, inclusive, Room 301, Service Memorial Institute, 426 N Charter St., Madison 6

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#### CUBA

*Sociedad de Radiología y Fisioterapia de Cuba*—Offices in Hospital Mercedes, Havana. Meets monthly

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## ROENTGEN DIAGNOSIS

### THE HEAD AND NECK

**Lipoma of the Corpus Callosum** A Clinicopathologic Study Carl F List, John F Holt, and Marjorie Everett Am J Roentgenol 55 125-134, February 1946

Two cases of lipoma of the corpus callosum are recorded, bringing the total number in the literature to 30. Anatomically these lipomas are encapsulated tumors lying on the dorsal surface of the corpus callosum beneath the leptomeninges, usually occupying the anterior portion although they may extend posteriorly. The size and consequently the normal structures involved vary. The anterior cerebral arteries are incorporated in the tumors. Histologically the lesion is typical of lipoma found elsewhere in the body. No neural elements appear, but calcification either as psammoma bodies or islands of true bone is present. Associated central nervous system or skeletal anomalies are common. Theories as to pathogenesis vary, but the authors consider the explanation that the lipoma is a tumor like malformation arising from primitive membranes of the brain as the most acceptable. There is no predilection for sex or age, and there is no diagnostic clinical syndrome. Roentgen diagnosis is, however, sometimes possible, though little stress has been placed on this in the literature.

Roentgenologically, the diagnosis may be made on the basis of a well circumscribed area of radiolucency in the mid line in the frontal region, calcification, which may outline the tumor in plain skull films, encephalographic findings of wide separation of the lateral ventricles anteriorly and concave mesial margins of the lateral ventricles.

Surgery is contraindicated because of the close relationship of the anterior cerebral arteries.

ELIZABETH A CLARK, M D

**Injection of Oxygen into Tenon's Capsule** Harold G Scheie and Philip J Hodes Arch Ophthalm 35 13-14, January 1946

The injection of a contrast medium into Tenon's capsule (Spackman Am J Ophthalm 15 1007, 1932) is an invaluable procedure for the roentgenographic localization of intraocular foreign bodies. In the authors' experience oxygen is superior to air and carbon dioxide for this purpose. It produces excellent visualization of the globe, it is absorbed slowly enough to permit re-examination when necessary, yet fast enough to avoid the risk of vitreous escaping at operation. Spackman's technique for injecting air into Tenon's capsule was used and is described again here. The authors found their results with this procedure more accurate than with the stereoscopic method of Griffin, Gianturco, and Goldberg (Radiology 40 371, 1943), in which a semi-opaque artificial eye is used to outline the globe.

### THE CHEST

**Chest Photoroentgenography in Army Physical Examinations** Israel A Schuller Am Rev Tuberc 53 103-114, February 1946

The results of routine radiographic examination of the chests of 40,283 men examined at the Buffalo Induction Station are presented. Eight hundred and fifty-six (2.12 per cent) were rejected because of pul-

monary disease, and in approximately 75 per cent of these, the disease was tuberculosis. The highest rejection rate occurred among the older men, due to a greater prevalence of arrested tuberculosis.

One of the valuable contributions of the Army x-ray program has been the detection of non-tuberculous pulmonary disease. There were 224 rejections for various chest lesions other than tuberculosis. Bronchiectasis was the most frequent (51 cases). Other significant findings were pneumonitis, 45 cases, disease of the pleura, 44 cases, pulmonary fibrosis and emphysema, 32 cases, mediastinal lymphadenopathy, 16 cases, pneumoconiosis, 11 cases. L W PAUL, M D

**Silent and Masquerading Intrathoracic Lesions. Importance of Proper Identification of Lesions Discovered During X-Ray Surveys** Richard H Overholt and Norman J Wilson New England J Med 234 169-180, Feb 7, 1946

With the advent of mass roentgenologic chest surveys, many lesions are discovered which are not necessarily identified but should be studied and defined for proper treatment.

In tuberculosis, the roentgenogram defines the extent of the disease, but clinical and other laboratory examinations are necessary to demonstrate activity of the process. Examination of sputum, and gastric washings, cultures, and guinea-pig inoculation are all sometimes necessary for determination of activity. Stereoscopic x-ray films, spot films, and fluoroscopy are often required. In the early period of the disease, chest films every one to two weeks are necessary to show spread.

Carcinoma of the lung may be first discovered during a chest survey. It is a disease of middle life but may occur at any age. It is seen about four times as frequently in the male as in the female. In very early cases there may be no change shown on the film. Later the bronchus is blocked and localized emphysema develops. As the disease progresses, atelectasis will occur. Many of the changes depend upon the location of the tumor. Bronchoscopy is a valuable procedure, especially for securing a biopsy. Aspiration biopsy should be done with caution. Exploratory thoracotomy is coming into more general use and approval with the lowering of mortality rates and advances in technique.

Mediastinal tumors have been shown to be more frequent than previously suspected. Some of these growths are benign, others malignant. Irradiation will control the lymphomata temporarily. Other tumors can be removed surgically.

The authors advise that, once a chest lesion is discovered, every means be used to identify it. Delay or watchful waiting should never be practiced.

JOHN B MCANENNY, M D

**A Tuberculosis Survey in New Orleans** Chester A Stewart New Orleans M & S J 98 330-334, January 1946

Between October 1943 and July 1945 more than 20,000 persons in New Orleans and vicinity were examined for tuberculosis by photofluorography, 8,571 of this number received in addition the Mantoux test and it is with this group that the present paper deals. Tuberculin testing of persons representing the lower socio-

economic level disclosed that throughout the entire life span tuberculosis is much more prevalent among the poor colored population than among the poor white population. The difference between the two groups roughly parallels that existing between their respective current tuberculosis death rates (in 1944, 103.6 for the colored race and 35.2 for the white race). The photofluorographic study resulted in the discovery of pulmonary infiltrations in 103 patients. In general the study demonstrated that photofluorography is of value in detecting pulmonary lesions, but subsequent investigations are needed for accuracy in diagnosis.

Cardiac and aortic enlargement were found to be more prevalent in the colored than in the white patients, a difference which is attributed to the relatively higher incidence of syphilis in the Negro.

**A Note on the Occurrence of Silicosis in Bituminous Coal Miners** Maurice J. Small. *West Virginia M J* 42: 6, January 1946.

The author calls attention to the not generally known fact that silicosis occurs rather frequently in miners operating coal cars in bituminous mines as well as among anthracite miners and granite and sandstone cutters. Ten such cases, with typical clinical and roentgen findings, have been encountered during the past four years, two of these patients developed silico-tuberculosis.

All of the men in this series operated the cars that haul coal from the pit to the surface. The grade is quite steep in this ascent and sand is sprinkled on the wheels to increase traction, this is ground into a heavy cloud of dust of sufficiently small size to cause silicosis. This hazard has been recognized by the coal companies and in recent years masks have been issued to the miners thus exposed.

**A Health Survey of Pipe Covering Operations in Constructing Naval Vessels** Walter E. Fleischer, Frederick J. Viles, Jr., Robert L. Gade, and Philip Drinker. *J Indust Hyg & Toxicol* 28: 9-16, January 1946.

An industrial health inspection of an important U. S. Navy Contract Yard indicated that dustiness from miscellaneous pipe-covering operations was considerable and that a few of the employees had what appeared to be an asbestosis. The important ingredient of pipe-covering material used in U. S. Navy vessels is amosite, a magnesium iron silicate of variable composition. Since the pipe coverer may rotate between shop and ship and from small to large ship compartments, with a wide variation in dust exposure, conclusions drawn from other asbestos industries cannot be applied. Examinations were made of the working conditions, including dust counts of the air breathed and microscopic and chemical analysis of the dust itself, at two Government Navy Yards and two Navy Contract Yards. X-ray examination of the chests of 1,074 workers at the four yards revealed only 3 workers with asbestosis, 2 of these men had been pipe coverers for more than twenty years, and the third had worked in the asbestos industry for twenty three years before coming to work in the yard. From this study it is concluded that pipe covering is not a dangerous occupation. The most dusty operations, however, should be equipped with exhaust ventilation to keep the total dust concentration low.

**Reaction Following Bronchography with Iodized Oil** George S. Mahon. *J A M A* 130: 194-197, Jan. 26, 1946.

A brief review of the literature on reactions to lipiodol when used in bronchography is given. Only 19 cases could be found with severe reactions (8 with fatal termination), but the number of bronchographic examinations from which this group originated is not known.

The author presents in detail the history (including autopsy findings) of a patient who died following bronchography with lipiodol. The examination was made at 9:00 A. M., at 10:30 a severe generalized convulsion occurred, and death ensued almost immediately, 75 minutes after introduction of the contrast medium. The autopsy findings suggested an allergic asthma, though in the absence of clinical symptoms no inquiries had been made into this phase of the history. The explanation given for the death is that the tracheobronchial tree was allergically prepared to act as a shock organ and reacted to some constituent of the lipiodol, presumably iodine. Death resulted from bronchial obstruction from thick mucus, with massive pulmonary collapse and subsequent asphyxia.

**[EDITORIAL NOTE]** In a communication in the Correspondence columns of the *J A M A* (130: 599, March 2, 1946) Dr. George L. Waldbott differs with Mahon as to the cause of death in this case. He considers the interval between the instillation of the lipiodol and the development of the "reaction" too long to attribute it to an allergic factor. "Since the pathologic condition described was typical of death from allergic asthma and since death was due to obstruction of the bronchi by mucous plugs, the preexisting asthma and bronchiectasis should be held solely responsible."

Waldbott draws two lessons from the case: (1) If an asthmatic patient has much mucus in the bronchial tree, a lipiodol injection should either be avoided or preceded by bronchoscopic aspiration of mucus. (2) When an accident of this kind occurs, the first measure should be the immediate insertion of a bronchoscope and the aspiration of the obstructing material.

R. S. MACINTYRE, M.D.  
(University of Michigan)

**Primary Mesothelioma (Endothelioma) of the Pleura. Case Report.** Arnold D. Piatt. *Am J Roentgenol* 55: 173-180, February 1946.

The incidence of primary mesothelioma of the pleura is estimated at 1.1 per thousand necropsies. The author's patient was a 33-year-old white woman who was observed over a period of two years. The presenting symptom was persistent chest pain, associated with loss of energy and dry cough. At the time of the first examination, the chest roentgenogram was interpreted as serofibrinous pleurisy over the left diaphragm, fluoroscopically there was limitation of motion of the left diaphragm. Fifteen months later a second roentgen examination showed enlargement of the cardiac silhouette, pleural effusion obscuring the left lower lung field, and hilar and central root branch thickening on both sides, extending toward the bases, as well as thickening of the right upper interlobar septum. Six weeks after this a dense mass was demonstrated roentgenoscopically and kymographically in the left oblique position, arising from the region of the lower left heart silhouette and in close relation to the cardiac shadow.

Plural mesothelioma was suggested at this time but only as a remote possibility, bronchiogenic carcinoma being considered a more probable diagnosis. This opinion was strengthened a month later, when severe pain developed in the pelvis and lower spine and metastatic infiltration was demonstrated in the pelvic bones.

Palliative roentgen therapy was given to the chest and the pelvis, but relief of pain was only transient. Repeated thoracentesis was done, but no malignant cells were found in the aspirated fluid. Some difficulty was experienced in forcing the aspirating needle into the pleural space, but the diagnostic significance of this was not appreciated. Terminally blood appeared in the aspirated fluid and dyspnea became severe.

Autopsy showed primary mesothelioma (endothelioma) of the left pleura with an old encapsulated pleural serofibrinous hemorrhagic exudate, complete compression atelectasis of the left lung, metastases to the pericardium, the right visceral pleura, both lungs, the mediastinal lymph nodes, and the eighth left rib and pelvis.

The clinical and roentgenological manifestations of this type of tumor are confusing, and the effect of radiation therapy is open to some question. In the reported case, no positive evidence of radiosensitivity could be demonstrated microscopically. However, dosage may have been inadequate because of the other factors involved. On the other hand, the possibility that a stimulating dose may have been given to the neoplasm must be kept in mind.

ELIZABETH A. CLARK, M.D.

**Experience in the Localization of Thoracic Foreign Bodies.** Benjamin Burbank, Thomas H. Burford, Paul C. Samson, and Sidney Mesrow. *J. Thoracic Surg.* 15: 64-75, February 1946.

An x-ray machine capable of making chest films and a fluoroscope are all the equipment necessary for the method described by the authors for the localization of foreign bodies in the chest. Postero-anterior and lateral films of the chest are made first and the lung fields are divided by vertical lines into three sectors, each one of which is roughly one-third of the lung diameter. In the postero-anterior view each lung field will be divided into these three sectors, with the middle of the mediastinum as the dividing line. The sectors are labeled A, B, and C in the postero-anterior view and A', B', and C' in the lateral view. If a foreign body is in the middle sector in both views (i.e., in B and B'), it must be in the lung. In all other combinations of sectors more study is necessary to decide whether the foreign body is intrapulmonary or extrapulmonary, or in the mediastinum. Usually fluoroscopy is the next step, with spot films made in the oblique projection, which demonstrates the closest approximation of the foreign body to the chest wall. If the localization is still in doubt, a diagnostic pneumothorax may be done. In cases with a foreign body near the diaphragm, it may be necessary to do a pneumoperitoneum, followed by upright films and fluoroscopy and spot films.

Several case reports with reproductions of the films are included to illustrate foreign bodies in different positions. The main objective in all cases is to determine whether the foreign body is in the chest wall, pleural cavity, lung, mediastinum, or below the diaphragm. More accurate localization—centimeters distance from any particular point—is not considered necessary.

HAROLD O. PETERSON, M.D.

## THE DIGESTIVE SYSTEM

**Abdominal Lymphogranulomatosis.** Lloyd F. Craver and Julian B. Herrmann. *Am. J. Roentgenol.* 55: 165-172, February 1946.

The involvement of the gastro-intestinal tract by Hodgkin's disease may be classified as primary, secondary, and extrinsic. Primary lymphogranulomatosis may involve any part of the gastro-intestinal tract or several segments concomitantly. It is most frequent in the stomach, where it produces a filling defect usually interpreted as due to cancer or ulcer. Superficial lymphadenopathy is seldom present. In the secondary group the gastro-intestinal lesions are part of a generalized process. Symptoms may be absent and the involvement of the digestive tract may be discovered only on postmortem examination. In the third group of cases there is no clinical, roentgenologic, or gastroscopic evidence of intrinsic gastro-intestinal involvement, but symptoms are due to extrinsic pressure by enlarged abdominal lymph nodes.

Of 406 patients with Hodgkin's disease (proved by biopsy) seen at Memorial Hospital between 1932 and 1942, 52 (12.8 per cent) had gastro-intestinal symptoms. Of these, 7 were found (at autopsy in 6 cases, and on gastroscopy in 1) to have specific gastro-intestinal lesions of the secondary type, while in 45 the complaints were presumably of extrinsic origin. Roentgen studies of the gastro-intestinal tract were carried out in 33 patients, or 63 per cent of those with gastro-intestinal symptoms. In approximately 50 per cent no abnormality was discovered.

It was found that patients in whom gastro-intestinal symptoms developed during the course of the disease had a life expectancy of one year and two months longer than the average life expectancy for all cases of Hodgkin's disease. For those patients whose earliest complaints were gastro-intestinal, however, the average duration of the disease was only nine and one-half months. It has been suggested that since the abdominal organs are able to adjust themselves to slowly growing extrinsic masses, symptoms from Hodgkin's involvement of the retroperitoneal lymph nodes do not occur until relatively late in the course of the disease.

Therapy for the primary type of abdominal lymphogranulomatosis is surgical, and survivals of six to eight years have been recorded. Radiation therapy for the secondary and extrinsic types is palliative, but does not increase the life expectancy.

ELIZABETH A. CLARK, M.D.

**A Roentgenologic and Gastroscopic Study of Gastric Disease.** William E. Ricketts and H. Marvin Pollard. *Gastroenterology* 6: 1-6, January 1946.

An analysis is made of 1,297 patients who were studied both by x-ray and gastroscopy. Patients in whom the diagnosis was the same by the two methods (760, or 50.6 per cent), those with lesions of the duodenum recognizable only by roentgen examination, and those with previous gastric surgery were excluded from the comparative study.

In 355 patients, the gastroscopic and roentgen diagnoses disagreed. Gastroscopy failed to reveal the lesions seen roentgenologically in 46 cases (benign ulcer, 22, carcinoma, 21, benign polypoid, 3, gastric diverticulum, 1). Conversely, positive gastroscopic and negative x-ray evidence was obtained in 309 cases.

(chronic gastritis, 269, benign ulcer, 26, carcinoma, 10, benign polyp, 4) In 3 cases an incorrect diagnosis of carcinoma was made by both gastroscopy and x-ray. The lesion in each instance was a severe inflammation of the lower stomach.

**Pitfalls in Localizing Intestinal Obstruction with the Scout Film.** George Vash, Karl J. Myers, and Hu C. Myers. *West Virginia M J* 42 7-9, January 1946.

The authors review the literature concerning radiography of the abdomen for diagnosing intestinal obstruction and report a case. Their patient was a 57-year-old man with pain in the abdomen, bloating, nausea, and vomiting. These symptoms had been present for two weeks and bowel movements ceased four days before hospital admission. The abdomen was distended and slightly tender throughout, and several nodules of varying size were present in the rectum. A scout film, taken with the patient erect and the central ray horizontal, showed distention of the loops of the jejunum and ileum, with no gas in the colon, suggesting a small bowel obstruction. Several attempts to pass a Miller-Abbott tube beyond the pylorus failed completely. Since the patient's general condition did not permit exploration, an ileostomy was done. Only a small amount of fluid and gas was obtained from the small intestine, and during the following day it became clear that the distention had been only partly relieved. Death occurred on the sixth postoperative day. Autopsy showed the large bowel completely filled with soft fecal material and the small bowel moderately distended. At the rectosigmoid junction was an annular mass which had so constricted the lumen that only a narrow slit remained. Histologic study revealed a papillary adenocarcinoma.

The erroneous x-ray findings which led to the decision to do an ileostomy can be explained only by assuming that the obstruction was not quite complete. All the gas of the colon evidently found its way through the narrow slit-like canal which remained at the site of the neoplasm. The solid particles of fecal material could not pass through this tiny opening and gradually filled the entire colon proximal to the carcinoma. This portion of colon, impacted with feces, acted as a closed loop and caused a secondary small bowel obstruction. The authors believe that the case proves that accurate localization of an intestinal obstruction with a scout film is not always possible.

J. E. WHITELEATHER, M.D.

**Tuberculous Ulcerative Colitis or Ulcerative Colitis with Superimposed Tuberculous Infection. A Case Report.** Paul M. Glenn and Hilton S. Read. *Gastroenterology* 6 9-20, January 1946.

The authors report a case of ulcerative colitis with an ischio-rectal abscess from which tubercle bacilli were isolated, but with no active pulmonary disease demonstrable roentgenologically or at autopsy. Whether the case represents a primary intestinal tuberculous infection or a superimposed tuberculous infection is undetermined. Either occurrence is unusual.

A barium enema study demonstrated features characteristic of advanced chronic ulcerative colitis, while examination of the upper intestinal tract showed a constricting lesion of the distal ileum and jejunal changes suggestive of a secondary deficiency state. Late in the course of the disease, acid fast bacilli, believed to be

*Mycobacterium tuberculosis*, were found in cultures from a draining perianal sinus and in the feces. The tuberculin test was negative and examination of gastric washings on three occasions showed no acid-fast organisms.

The patient, a 22-year-old soldier, died after ninety-one days in the hospital. The principal autopsy findings were those of a non-specific chronic ulcerative colitis. A large abscess filled the left ischio-rectal fossa. Cultures and smears from this abscess and from the peritoneal cavity yielded *Mycobacterium tuberculosis*.

**Massive Calcification of the Liver. Case Report with a Discussion of Its Etiology on the Basis of Alveolar Hydatid Disease.** Norman Heilbrunn and Andrew J. Klein. *Am J Roentgenol* 55 189-192, February 1946.

Calcification within the liver parenchyma is an unusual roentgenographic finding. The most common cause is echinococcus or hydatid disease, usually of the unilocular type. In this form the mother cyst is encapsulated and the daughter cysts are produced by invagination of the germinal layer. Calcification may occur in the capsular tissues and is demonstrable in the roentgenogram as a smooth curvilinear shadow.

The author's case is representative of a less familiar form of the disease, the alveolar type, seen principally in Central Europe. In these cases the daughter cysts are produced by evagination, there is no limiting capsule, and infiltration of the organs of the host occurs as in the case of malignant growth. Death of the parasite may be followed by massive calcification.

The patient was a 32-year-old white soldier who had been born in Czechoslovakia and had lived there until he was 9 years old. Roentgenograms of the abdomen showed an irregularly calcified non-encapsulated mass measuring 12 cm., in the left lobe of the liver, and numerous similar but smaller calcifications in the right lobe. Although neither complement-fixation nor skin tests were positive for echinococcosis, other causes of calcification in the liver were excluded, and since the patient was known to have lived in an area where the disease is prevalent, the case is believed to represent calcification in alveolar hydatid disease. The negative immunologic tests are attributed to the complete death of the parasite, with loss of antigenic properties.

ELIZABETH A. CLARK, M.D.

## THE MUSCULOSKELETAL SYSTEM

**Skeletal and Pulmonary Metastases from Cancer of the Kidney, Prostate and Bladder.** Jacob R. Freid. *Am J Roentgenol* 55 153-164, February 1946.

The incidence of skeletal and pulmonary metastases in 203 cases of carcinoma of the kidney, prostate, and bladder was investigated. In almost all of the cases roentgenographic as well as autopsy material was available. Of 87 patients with carcinoma of the kidney, 45 per cent had skeletal metastases and 54 per cent had pulmonary or pleural metastases. Bone lesions, always destructive in character, were found to be either single or multiple and to have a predilection for the upper ends of the long bones near the nutrient vessels. In the chest, parenchymal lesions predominated, indicating the mode of spread as hematogenous.

Of the 60 patients with carcinoma of the prostate, 58 per cent had skeletal metastases, and in only 3 cases were these purely osteoclastic. The pelvis, spine, and

femur were most frequently involved, with the ribs, scapula, clavicles, humerus, and skull following in the order named. Of the prostatic group, 43 per cent had pulmonary involvement. A combination of pleural and parenchymal lesions was the most frequent finding, indicating the mode of spread as both hematogenous and lymphogenous.

Direct extension of carcinoma of the bladder (total 56 cases) to bone was found in 5 cases and true metastasis but once. Pulmonary lesions were found in 7 per cent of the series, and in these cases there was extension of the primary tumor to regional nodes.

Röntgen therapy, in dosages of 2,000 to 3,000 r, gave palliation of pain in the skeletal metastases. Decrease in the rapidity of fluid formation was obtained by irradiation of the pulmonary lesions, but otherwise there was little effect. ELIZABETH A. CLARK, M.D.

### THE BLOOD VESSELS

**Distention or Collapse of the Vena Cava.** Radiologic Study. J. Duomarco, R. Rumm, and F. M. Predari. *Rev argent de cardiol* 12: 333-344, January-February 1946.

A roentgen study of the vena cava in dogs was made by rapid injection of a 40 per cent solution of sodium iodide. It was found that the state of distention or collapse of the thoracic vena cava does not depend on the existence of a negative thoracic pressure, but on the position of the animal, collapse occurring when the dog's head is up, in the vertical position, and distention when the head is down, in the vertical position. No appreciable changes in the form of the inferior vena cava were elicited by passing from one vertical position to the other, nor by heart stoppage, which suggests the existence of special conditions. These facts confirm previous manometric observations.

### THE GENITO-URINARY SYSTEM

**Case of Pyelitis and Cystitis Cystica.** Lino J. Arduno. *J Urol* 55: 149-152, February 1946.

The author describes a case of pyelitis cystica diagnosed by pyeloureterography and proved by biopsy. The patient has been treated with sulfathiazole and has improved symptomatically.

The theory of pathogenesis of this condition as formulated by von Brunn in 1893 is accepted as satisfactory by the author. von Brunn described down-growing "epithelial sprouts" which formed "epithelial nests" in the submucosa. According to his view, the stalks of these nests become pinched off, they proliferate, their centers degenerate, and they reappear as cysts along the urinary tract. Etiological features include chronic infection, obstruction, carcinoma, etc.

Clinical diagnosis of pyelitis and cystitis cystica is a fairly recent development. The disease should be suspected with a history of chronic infection and

hematuria. Characteristically the pyelogram shows filling defects of either the renal pelvis or the calices, dilatation of the ends of major calices, narrowing of the arms of the calices below, and cystic dilatation of the uretero-pelvic junction. The ureterogram shows typical mottling caused by non-opaque filling defects in the outline of the ureter. JAMES C. KATTERJOHN, M.D.

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A 34-year-old soldier suffered from pain in the left renal area with radiation anterior and downward to the left testicle. Gross hematuria and fever were also present, but the latter was controlled by sulfadiazine. Cystoscopic examination overseas showed blood coming from the left ureter, but pyelograms were reported as being essentially negative. Pyelographic study after the patient's return to the United States revealed a small filling defect in the left upper calyx, simulating papilloma of the renal pelvis. The right kidney was small and poorly developed, suggesting previous infection. Because of possible insufficiency of the right kidney, a left heminephrectomy rather than a nephrectomy was performed. Pathologic studies revealed an angioma. Convalescence was relatively uneventful.

The author concludes that the only consistent symptom of angioma of the kidney is hematuria, which is usually intermittent and may produce colic. Though a preoperative diagnosis cannot be made with present methods, the diagnosis may be suspected in the presence of hematuria and a filling defect in the pyelogram in a subject under forty years of age. The absence of a tumor or the absence of x-ray evidence of enlargement of the kidney tends to support this suspicion.

FREDERICK A. BAVENDAM, M.D.

### APPARATUS

**First Practical Experiences with a Mobile Radiophotographic Unit in Switzerland.** E. A. Zimmer. *Schweiz med Wchnschr* 75: 501, 1945.

The author describes the first photofluorographic unit used in Switzerland. The nature of the terrain necessitated a somewhat special construction, including a rather lighter cart than is usual and provision for horse rather than motor transportation. The electrical supply was obtained from local sources through a 30 ft cable, although the voltage drop in the local lines was a source of embarrassment and sometimes necessitated increasing the exposure time. Development was accomplished by use of dressing room space within the cart. The paper discusses at some length the administrative and technical aspects of obtaining satisfactory films, and also the use of fluoroscopy as a means of investigation. The author feels that while fluoroscopy is important in individual cases, films are more suitable for serial examinations.

LEWIS G. JACOBS, M.D.

### RADIOTHERAPY

**Treatment of Inoperable Carcinoma of the Breast with Irradiation.** Charles L. Martin. *Surgery* 19: 132-148, January 1946.

In spite of the good results obtained with radical surgery in early cases of cancer of the breast, less than one fourth the patients entering cancer clinics today can

hope for a surgical cure. Haagensen and Stout (*Ann Surg* 118: 859, 1943), reporting on 640 cases treated by radical mastectomy, showed that 22.2 per cent of the total number could be classified as five-year cures, while the remaining 77.8 per cent required some form of palliative therapy. Data are presented by these same



writers upon which a choice between radical and palliative therapy may be based

For palliative irradiation the author favors in general the implantation of weak radium needles as advocated by Keynes. A minimum of sloughing and fibrosis is produced, and both primary and secondary tumors in and about the breast are often completely eradicated. Methods of implanting the needles and calculating dosage have been described elsewhere (see *Am J Roentgenol* 48 377, 1942).

The alveolar structures of the lungs are especially sensitive to x-rays. Extensive pulmonary fibrosis has resulted from doses of approximately 50 T E D, and in some instances the radiation reaching the lung amounted to only 2.5 T E D. A patient can survive with even an entire lung fibrosed, but elevation of the dosage above safe limits for the pulmonary structures frequently produces a radiation osteitis in the ribs, with pathological fractures. Palliative irradiation should be given with technics which reduce such sequelae to a minimum. In the author's clinic 15-cm. portals are treated with 2,100 to 2,400 r at the rate of 300 r daily.

Improvement has been reported in approximately 25 per cent of breast cancer patients treated by surgical castration, and similar good results have been obtained with irradiation castration. The method is most useful in the presence of bone metastases and should always be tried in patients who have not reached the menopause. The author applies 600 r to each of four 15-cm. portals, treating one area per day for four successive days. The menopause should be fully established about six weeks after completion of this therapy.

For controlling radiation sickness, mention is made of the barbiturates and vitamin B complex. The latter has been found effective not only in offsetting the ill effects of radiation but also in improving the general condition of the patient. Reference is also made to the possible value of pyridoxine hydrochloride (vitamin B<sub>6</sub>) which has been found effective in controlling the nausea and vomiting of pregnancy. [For reports on the use of this preparation in radiation sickness, see papers by Van Haltern, by Oppenheim and Lih, and by Scott and Tarleton in *Radiology* 47 377, 381, and 386, October 1946.—Ed.]

Following these general considerations, the author takes up the various types of lesions to be treated, as follows:

**Large Tumors of the Breast in Incurable Cases.** When large masses of malignant tissue have become necrotic and are producing a foul odor, surgical resection offers quick symptomatic relief. Often, however, these large tumors will show marked shrinkage after irradiation. The multiple single-dose method through four to six sectors is quite satisfactory, but most radiologists prefer to crossfire the tumor through two or three portals, using a divided dose tangential technic at 200 kv. Each portal may be given 2,100 to 2,400 r at the rate of 300 r per day to each area.

**Involvement of the Skin.** Skin metastases are almost always a bad prognostic sign. Occasionally radical treatment of a small single recurrent nodule is successful but the common surgical practice of removing one recurrence after another from the skin and subcutaneous tissues has little to commend it. The author prefers the implantation of low-intensity needles around the lesion in these cases and also in parasternal masses. In the presence of multiple nodules or cancer en cuirasse no type of treatment will cure the disease. Prolonged

improvement, however, often follows the use of divided doses of x-rays generated at 200 kv. The entire anterior chest wall should be divided into 15-cm. squares, 1,800 to 2,100 r being administered to each at the rate of 300 r daily.

**Metastases in the Axillary Lymph Nodes.** For some reason which is not understood, cancer cells growing in lymph nodes are more resistant to irradiation therapy than the malignant cells found in the primary tumor. Axillary fat stands heavy irradiation very poorly and, although a combination of interstitial radium and a crossfire x-ray technic sometimes produces complete regression of cancer in axillary nodes, the resulting reaction is not justified in incurable cases. Implanted radium needles or radon seeds must be used with great care, so that an excessive dose will not reach the brachial plexus.

**Metastases in Supraclavicular Lymph Nodes.** Control of isolated supraclavicular nodes with heroic external irradiation necessitates severe damage to the skin, subcutaneous tissue, and clavicle, and for this reason the author prefers radium needle implantation. Supraclavicular nodes have remained quiescent for three to six years following this procedure. Larger areas must be treated with external irradiation, using a divided dose technic over a single portal. The skin of the base of the neck is easily damaged with x-rays and the total dose should rarely exceed 2,000 r. A rather severe reaction may be produced in the esophageal mucosa but this subsides shortly.

**Skeletal Metastases.** It has been known for years that relatively small doses of x-ray delivered directly to bone metastases of mammary origin often relieve pain and may produce a recalcification of the destroyed osseous structure. Striking results have been obtained by x-ray castration but no improvement has been observed following ovarian irradiation in any woman past the menopause. Relief of pain following radiation castration and 600 r delivered to each of two portals, crossfiring the bone lesion, usually begins in two or three weeks after the series is finished. Unfortunately results are not permanent but they often last one to three years. When pathologic fractures have occurred, x-ray therapy can be administered through windows cut in a plaster cast, and good union has appeared after the completion of irradiation therapy.

**Brain Metastases.** For intracranial metastases some neurological surgeons advocate operative removal when other parts of the body are relatively free of the disease. However the palliative results of irradiation are usually so good that this radical procedure seems unjustified. Relief of symptoms lasting from six months to two years has been observed, and the treatment can oftentimes be successfully repeated. The author's practice is to crossfire the affected portion of the brain through two or three portals when localization is possible. In other cases, the skull is treated through four triangular ports covering the entire cranial vault. Each area receives a daily dose of 300 r and a total dose of 1,800 r, only one area being treated per day.

**Spinal Cord Metastases.** The symptoms of spinal cord pressure usually result from lesions growing from the vertebral bodies, but occasionally the metastases are within the neural canal. Treatment of the type used for brain metastases is frequently effective if it is applied before permanent damage occurs.

**Intrathoracic Metastases.** On the whole, the treatment of intrathoracic lesions with roentgen rays is un-

furur were most frequently involved, with the ribs, scapula, clavicles, humerus, and skull following in the order named. Of the prostatic group, 43 per cent had pulmonary involvement. A combination of pleural and parenchymal lesions was the most frequent finding, indicating the mode of spread as both hematogenous and lymphogenous.

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**A Contribution to the Technique of the Radium Treatment of Cancer of the Cervix. A New Instrument.** A M Ritala. *Acta obst et gynec Scand* 25 305-324, 1945

The author describes an instrument designed to dis-tend the vagina dorsoventrally during the radium treatment of cancer of the cervix, thus preventing the radium from touching the vaginal walls, especially the recto-vaginal septum. The radium packing is kept in a stable position in the vagina against the portio, without re-

course to infection-promoting tamponage. The distance in each case can be read in centimeters direct from the dilator. The vaginal radium packings are placed in lead cases, one of the walls of which (the one against the cancer) is open. The lower arm of the dilator is strengthened and prolonged with metal screens suitable for each individual case. The instrument makes it possible to administer vaginally greater radium doses to the primary tumor itself.

Thirteen photographs and drawings are included.

## EFFECTS OF RADIATION

**Radiation Sickness in Nagasaki. Preliminary Report.** Joseph J Timmes. U S Nav M Bull 46 219-224, February 1946

This study of the radiation effects resulting from the explosion of the atomic bomb at Nagasaki was begun approximately thirty-three days after the initial blast and was terminated two weeks later. Follow-up reports have since been obtained. Some difficulty was experienced in obtaining case histories through non-medical interpreters, and laboratory tests had to be repeated because of differences in Japanese and U S standards. At first an average of 20 new patients were admitted to the improvised hospital daily, but within two weeks the admitting rate dropped sharply to one or two.

When an atomic bomb explodes, the concentrated energy is diffused in three main channels, namely, pressure, heat, and radiation, and its effects differ from the ordinary explosive bomb only in the release of radiant energy. The atomic bomb dropped on Nagasaki was exploded at an estimated altitude of 800 feet and much of the radiant energy was expended into the atmosphere.

The first concern was the amount of radiant energy remaining in the area and in the victims. X-ray film buried in the bombed area and attached to various objects about the so-called crater (a true crater does not exist) failed to reveal the presence of radioactive elements. Films attached to the limbs of atomic victims at the hospital and kept in place for eighteen hours likewise failed to reveal radiation. ☛ ☛ ☛

The patients showed true radiation sickness, and to this the Japanese attributed most of the deaths during the first week. They failed, however, to differentiate blast and radiation victims, and they attributed to radiation many thermal burns. It can be assumed, however, that a large percentage of the early victims died from the effects of radiation. Most of the civilians were not in air raid shelters when the bomb was dropped. Air raid shelters with concrete walls two feet in thickness probably would have afforded adequate protection. All of the patients observed had been within 3 kilometers of the center of the explosion.

There were only a few x-ray skin burns, and these were mild in character. Many cases of alopecia were seen. Some of the victims began to lose their hair four or five days after the explosion, while in others this occurred in about the third week. None of the patients had complete loss of hair. At the end of a month a few had a new growth of a downy nature. ☛ ☛ ☛

The principal effect of the radiation was on the bone marrow, with most of the patients showing an aplastic anemia. The blood was deficient in red blood cells and hemoglobin but was not markedly hypochromic. A

white cell count under 1,000 offered a poor prognosis, however, one patient with 400 cells per cu mm recovered. In some cases the white blood cells disappeared completely before death. Petechiae and gross hemorrhages were commonly seen. Bleeding times were increased and often were prolonged over forty-five minutes. Urin analysis frequently revealed albumin, casts, bile, and red blood cells.

Oral changes were common and consisted of a glossy, smooth tongue, with ulcerative lesions of the mucous membranes. The ulcers were composed of necrotic areas with a complete clinical absence of a surrounding inflammatory zone. The lesions bled easily, were often grossly infected, and showed no tendency to heal. Two cases of necrosis of the mandible and one case of noma with ulceration of the lips and necrosis of the mandible and maxilla were seen. The teeth were generally loose and easily removed by hand.

Many of the patients died as a result of terminal infection, particularly bronchopneumonia. Treatment was handicapped by limited supplies.

**Protection of Photofluorographic Personnel.** Russell H Morgan and Ira Lewis. *Am J Roentgenol* 55 198-202, February 1946

With a tempered presdwood phantom producing scattered radiation equivalent to that from a subject with a chest 24 cm thick, isodose curves were obtained for various locations around a standard 35-mm Westinghouse photofluorograph. Readings were made with the tube operating at 100 kv (peak), and curves are reproduced representing quantity of radiation in roentgens per 100 exposures.

The charts are applicable for other installations if the following conditions and conversion factors are considered:

- Exposure necessary for 70-mm and 4 X 5-inch units is 25 to 50 per cent greater than for 35-mm film.
- The use of a larger-than-average subject for the study reported gives an additional safety factor.
- Tube potentials of 90 kv (peak) and 80 kv (peak) increase dosage rates by 20 and 40 per cent, respectively, because of the increase in exposure time.
- Absence of a limiting cone increases the scattered radiation by an average of 30 per cent.
- Absence of a grid decreases the average dosage by 50 per cent.
- If the direct beam strikes walls of wooden or of cellulose construction, dosage increases by 50 to 100 per cent.

Observations made on protective materials show that thicknesses of aluminum and Masonite presdwood necessary for absorption equivalent to that of lead or steel make the former materials impractical. Ab-

satisfactory. This is partially due to the fact that the patient is likely to be suffering from generalized carcinomatosis by the time intrathoracic metastases are well established. Generalized pulmonary metastases should never be irradiated because of the serious changes produced in the lungs by efficient dosage. Occasionally it seems worth while to treat a single nodule when the patient is in good condition and other metastases are not demonstrable. Moderate doses may also be directed at the mediastinum with some temporary success when pressure symptoms from enlarged nodes produce severe distress. As a rule, better palliative results are obtained when irradiation of the thorax is omitted.

**Intra-Abdominal Metastases.** Abdominal extension, also, indicates a generalized dissemination of the disease. Although some radiologists advocate irradiation therapy over the abdomen, particularly when the liver is enlarged, the author believes that the questionable improvement obtained in no way offsets the objectionable symptoms of irradiation sickness which invariably follow this form of treatment.

Several illustrative case histories conclude this comprehensive discussion. J. E. WHITELEATHER, M.D.

**Treatment of Carcinoma of the Cervix at Charity Hospital II. Analysis of 716 Cases. Three-Year and Five-Year End Results.** Manuel Garcia and J. V. Schlosser. New Orleans M. & S. J. 98: 314-319, January 1946.

The authors report on a series of 716 consecutive cases of carcinoma of the cervix admitted to Charity Hospital (New Orleans) during the four-year period ending March 31, 1942. Since any patient with a clinical diagnosis of carcinoma of the cervix is accepted in that institution, even when moribund, the series is entirely unselected, except that cases without histologic proof have been eliminated. It has been possible thus to assess the absolute results in accord with the rules of the Radiologic Subcommittee of the League of Nations, which lends them special significance. They represent the minimum accomplishment of treatment, including untreated, incompletely treated, and untraced patients. Actually 96 per cent of all the cases have been traced.

The authors emphasize the point that x-ray therapy is an essential part of the treatment of carcinoma of the cervix and not an auxiliary measure to be used haphazardly. Their plan is to give x-ray therapy first, delivering a dose of 3,000 r = 15 per cent to the lateral edge of the parametria in a period of three weeks. This is followed in a few days by radium therapy—6,600 r to the paracervical region in five days (this requires an exposure of 6,500 to 8,500 mg. hours). The total duration of treatment is thirty to thirty-one days. The three-dimensional distribution of the combined irradiation then encompasses the main areas of involvement in a dosage range high enough to anticipate control of the disease in a substantial proportion of the cases.

This plan of treatment is obviously a compromise between theoretical completeness and practical possibility especially in regard to the treatment of the pelvic lymph nodes, but the authors feel that it is better to irradiate intensively the sites of frequent metastasis than to irradiate inadequately all possible areas of involvement, especially when such an attempt is associated with greater risk of immediate and late reactions. Certain modifications of the plan of treatment have to be made in some cases. In patients with severe infection

radium therapy may be impossible, and intravaginal therapy by Merritt's method has been substituted. In carcinoma of the stump and in recurrences, interstitial radium therapy must frequently be employed. In late cases x-ray therapy alone may be possible.

For tabulation of results, cases are grouped as *primary*, that is without previous treatment, *recurrent*, after treatment elsewhere, *prophylactic*, with apparently healed lesions after operation or radiotherapy. The three-year survival rate for the primary group (652 cases) is 37 per cent, for the recurrent cases (37 cases) 16 per cent, and for the prophylactic group (27 cases) 67 per cent. The rate for the entire series is 37 per cent. An analysis of the primary cases by stages shows a three-year survival rate of 82 per cent for stage 1, 50 per cent for stage 2, 31 per cent for stage 3, and 6 per cent for stage 4. The rate for white patients was somewhat higher than for colored patients, 42 as compared to 35 per cent.

Three hundred and twenty-nine patients were available for a five-year study. The five-year survival rate (without disease) for the primary cases (293) was 27 per cent, for the recurrent cases (22) 9 per cent, and for those treated prophylactically (14 cases) 43 per cent. The figure for the entire five-year group was 27 per cent.

The authors believe that the technic of treatment largely governs the proportion of primary and late reactions. Except for flare-up of infection, immediate reactions were mild and transient. Late sequelae were observed in 64 primary cases (9.8 per cent). The most frequent was retrovaginal fistula, in 23 cases or 3.4 per cent. Colostomy was necessary in 14 cases, or 2.1 per cent. Most of the secondary lesions arose from renewed activity of the tumor rather than from the direct effects of radiation, although the treatment must be held responsible in the sense that it failed to control the disease and allowed the development of complications.

The most important factor which influences the outcome of treatment is the stage of the disease when first seen. The authors have not found the age of the patient to be a significant prognostic factor. The recovery rate is distinctly lower in the colored race, probably because the general life expectancy of the Negro is lower and the incidence of advanced lesions, of infection, of incomplete treatment, and of untraced cases is greater than among white patients. Septic complications at the time of treatment were found to lower the survival rate significantly. Penicillin has proved an effective aid in controlling infection.

It is shown also, that of those patients who received 60 per cent or less of what the authors have determined as an effective dose, 32 per cent survived, of those receiving 90 to 120 per cent, 47 per cent survived, and of those receiving more than 120 per cent 39 per cent survived. This would indicate that there is no advantage in going beyond a definitely determined minimum effective dose.

The authors believe that there is abundant evidence to prove that when the criteria for the selection of cases to be treated by radiation or by surgery are the same, the results are the same, and the permanence of healing is the same. Radiation offers less primary risk and discomfort, and under skillful management its late sequelae are too infrequent to constitute a serious defect. The absolute salvage obtained by radiation is superior to that of operative interference since its greater safety and flexibility give it a much wider scope in the management of clinical material.

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sorption curves for lead and steel are given. It is stressed that since photofluorographic schedules often exceed 500 exposures per day, and since the amount of radiation per exposure is eighteen times greater than that for a 14 × 17 inch roentgenogram, protection of personnel must be carefully considered.

ELIZABETH A. CLARK, M.D.

**Reactions of the Hemopoietic System to Agents Used in the Treatment of Dermatoses** Frances Pascher and Ben Kance. *Arch. Dermat. & Syph.* 53: 1-5, January 1946.

Repeated exposures to irradiation may be harmful to the hemopoietic tissue and may cause alterations of the normal hemogram in the form of (a) mild leukopenia, (b) neutropenia, which may develop into agranulocytosis and cause death, (c) aplastic anemia, (d) thrombopenia, (e) leukocytosis, and (f) leukemia.

Leukopenia and a drop in the erythrocytic count after intensive irradiation have been reported by various authors. The cause of the change in the blood picture has been stated to be due to direct and indirect damage to the blood forming organs, while destruction of the circulating cells plays a minor role. Studies of the hemogram on patients receiving protracted fractional irradiation (Coutard technique) showed a leukocytosis the first few days, followed by a moderate leukopenia which returned to normal in two to four months.

Studies were made of the hemogram on 8 patients with generalized dermatosis, during the time they were receiving low-voltage radiation over large areas of the body. As a rule six fields were exposed at each treatment of 75 r each (100 kv, 1 to 3 mm Al). Three treatments were given a week for a maximum of eight weeks. Leukopenia, which was present in all cases, began to appear after three or four weeks. The white cell count dropped to 3,000 per cmm or less in 3 cases, the differential count, however, remaining unchanged. In some of the cases three to five months elapsed before the white count returned to normal. A moderate hypochromic anemia was found in all cases except one, where the red cell count dropped to 2,200,000.

The authors believe that the quantitative changes in the hemogram with low-voltage irradiation are about the same as those seen when high voltage therapy is used. Individual variations in radiosensitivity and dosage are primary factors in the development of leukopenia and anemia from low-voltage irradiation.

JOSEPH T. DANZER, M.D.

**Studies on the Effects of X-Rays on Phagocytic Indices of Healthy Rabbits. A Preliminary Report** John C. Glenn, Jr. *J. Immunol.* 52: 65-69, January 1946.

**Further Studies on the Influence of X-Rays on the Phagocytic Indices of Healthy Rabbits** John C. Glenn, Jr. *J. Immunol.* 53: 95-100, May 1946.

An investigation was undertaken to determine if x rays, directed to a local area in a healthy rabbit, would produce any effect on the phagocytic index of the treated animal, with hemolytic *Staphylococcus aureus* as the test organism. Eighteen healthy white male

rabbits, weighing from 1.7 to 3.5 kg, were selected. Blood specimens were obtained from the marginal ear veins under sterile precautions. As an anticoagulant, 0.1 ml of 5 per cent sodium citrate in physiological saline solution was added to each 0.5 ml of blood. All but the 2 animals which served as controls received 100 r (measured in air) over the inner surface of the left hind leg through a 6 × 6-cm port. The legs of the rabbits were not shaved or clipped. Group I, consisting of 4 animals, was treated at 90 kv, 5 ma, 8 inch skin target distance, and no filter (half-value layer 0.5 mm Al), Group II (6 animals) 140 kv, 20 ma, 30 cm skin-target distance, and 0.5 mm Cu plus 1.0 mm Al filter (half-value layer 0.5 mm Cu), Group III (2 animals) 200 kv, 20 ma, 30 cm skin target distance, with 0.5 mm Cu plus 1.0 mm Al filter (half-value layer 1.10 mm Cu), Group IV (4 animals) 400 kv, 5 ma, 80 cm skin-target distance, with 3.0 mm Cu filter (half-value layer of 5.2 mm Cu). This preliminary study showed that the phagocytic indices of healthy rabbits tested with *Staphylococcus aureus* increased significantly forty-eight to ninety six hours following radiation by 100 r (measured in air) delivered at 140 kv over a small area of normal skin.

The optimal kilovoltage having thus been determined, further studies were carried out to find the most effective single dose of x rays and the effect of repeating that dose at intervals. Hemolytic *Staphylococcus aureus* was again the test organism. In this investigation 35 healthy male rabbits weighing 2.0 to 5.1 kg were used. Techniques of obtaining blood and preventing coagulation were the same as in the previous experiment. The animals were divided into eleven groups to determine the effect of varying the dosage and of repeating the determined optimal dose. All treated animals received radiation generated at 140 kv through a 6 × 6-cm port over the inner surface of the unshaven and unclipped right hind thigh. Other factors were 18 ma, 20 cm target skin distance, 4 mm Al filter, and a half-value layer of 0.5 mm Cu. Two rabbits were given 50 r, 4 rabbits, 80 r, 6 rabbits, 100 r, 6 rabbits, 125 r, 6 rabbits, 150 r, 4 rabbits, 200 r, 3 rabbits, 250 r, 2 rabbits, 500 r, 4 rabbits, 1,000 r. Two groups of 2 animals each received 100 r at twenty four and forty-eight hour intervals, for a total of six and four treatments respectively. All doses are stated as measured in air.

It was found that the phagocytic index of the healthy white rabbit can be most effectively increased by a dose of 100 r. The maximal increase occurs forty-eight hours after treatment. Repetition of the optimal dose produces an increase in the phagocytic index which is only moderately higher than that obtained with a single dose, but the index may be maintained at a high level for a short time. There is a definite tolerance of the animals to x rays for producing an increase in the phagocytic index, beyond which point a depression occurs.

Previously irradiated animals show a return of the phagocytic index to normal at varying lengths of time following treatment, so that subsequent treatments following this event again institute a rise in the phagocytic index which is identical with that observed in untreated animals.

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